THE JOURNAL OF GAS LIGHTING
WATER SUPPLY & SANITARY IMPROVEMENT

VOL. LXVII. No. 1714.] LONDON, MARCH 17, 1896. [48TH YEAR. PRICE 6d.

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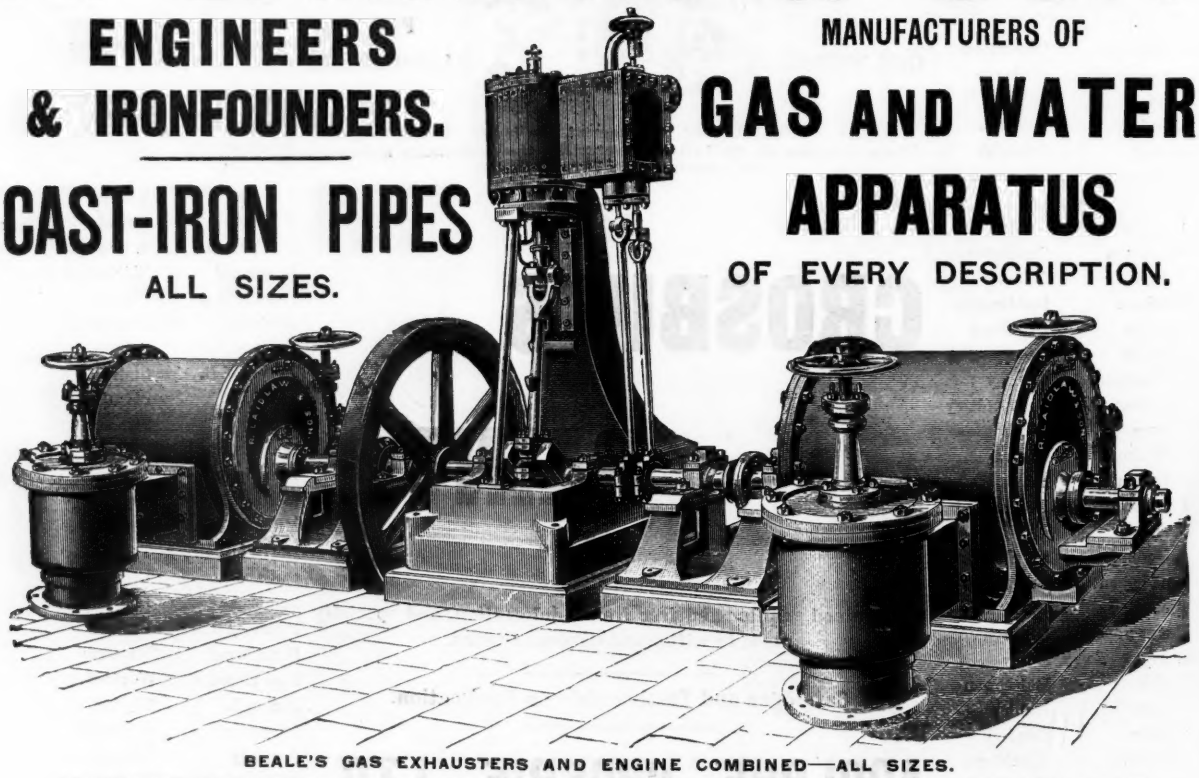

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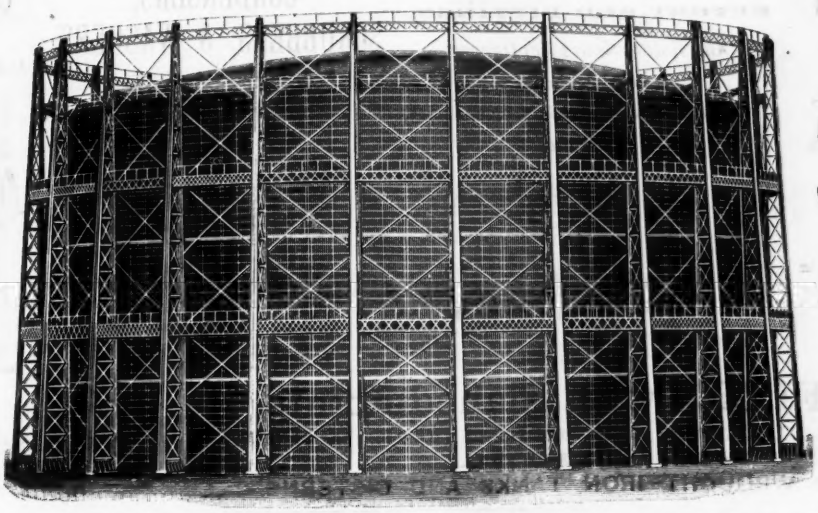

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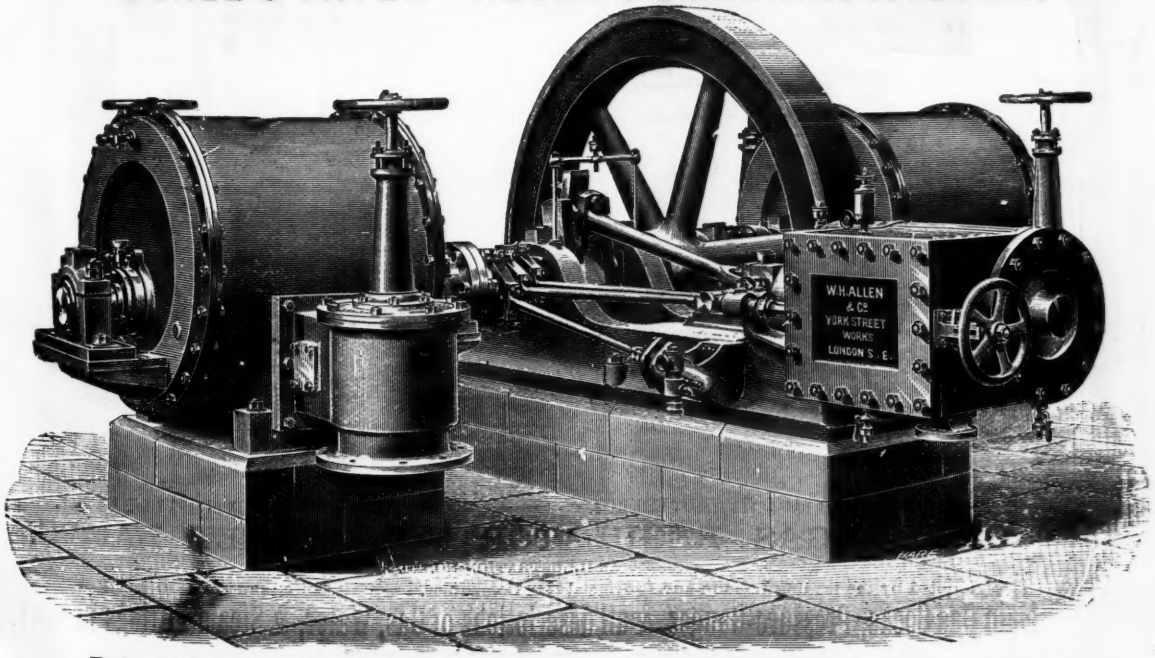

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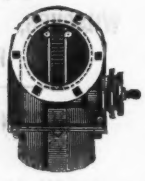

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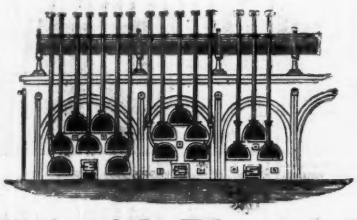

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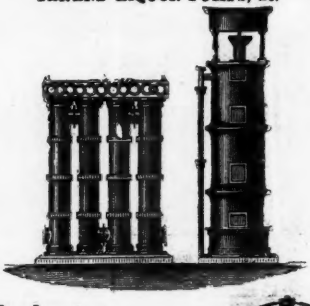

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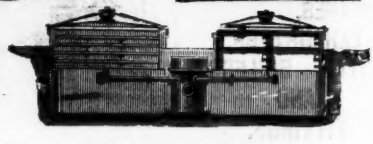

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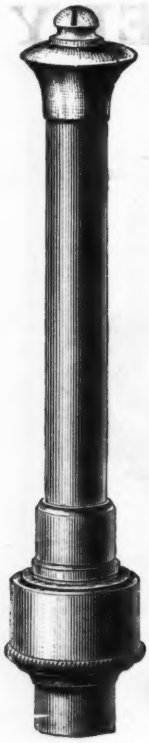

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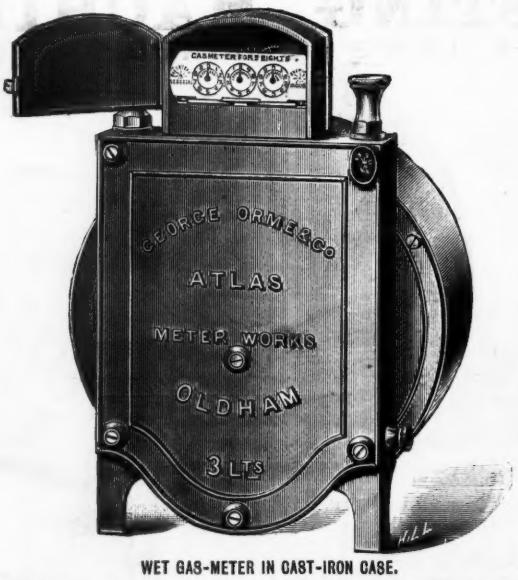
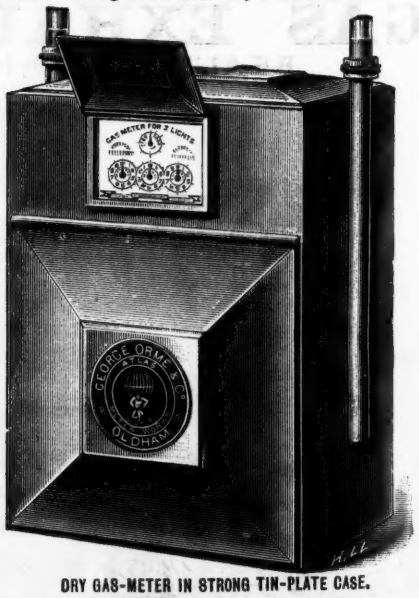


WET GAS-METER IN CAST-IRON CASE.



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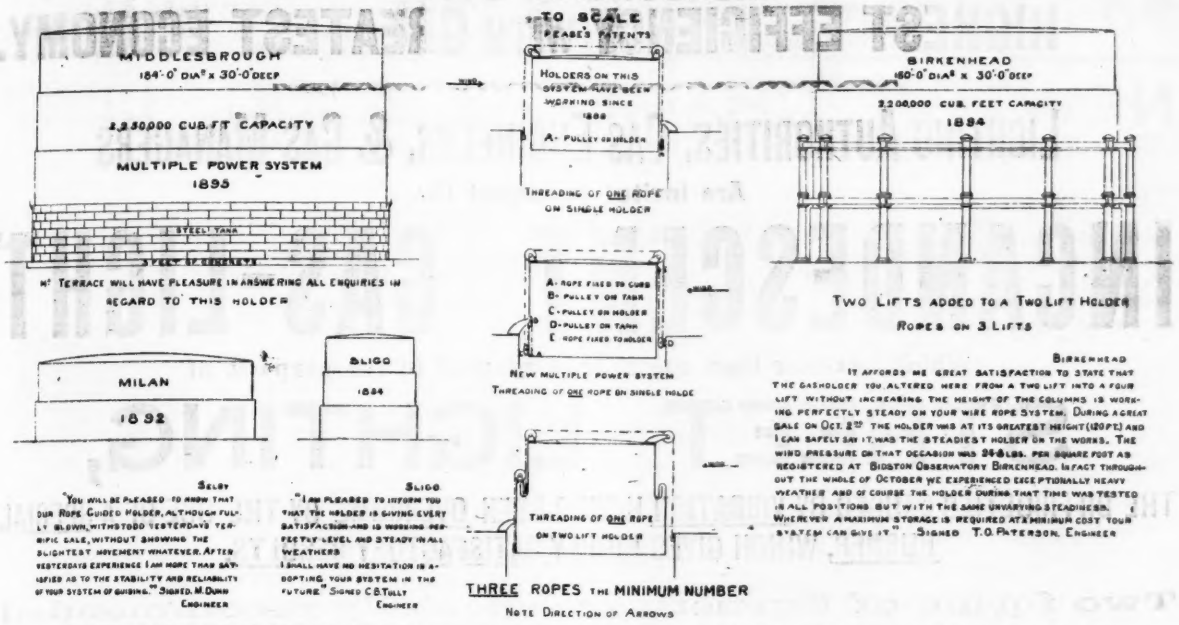

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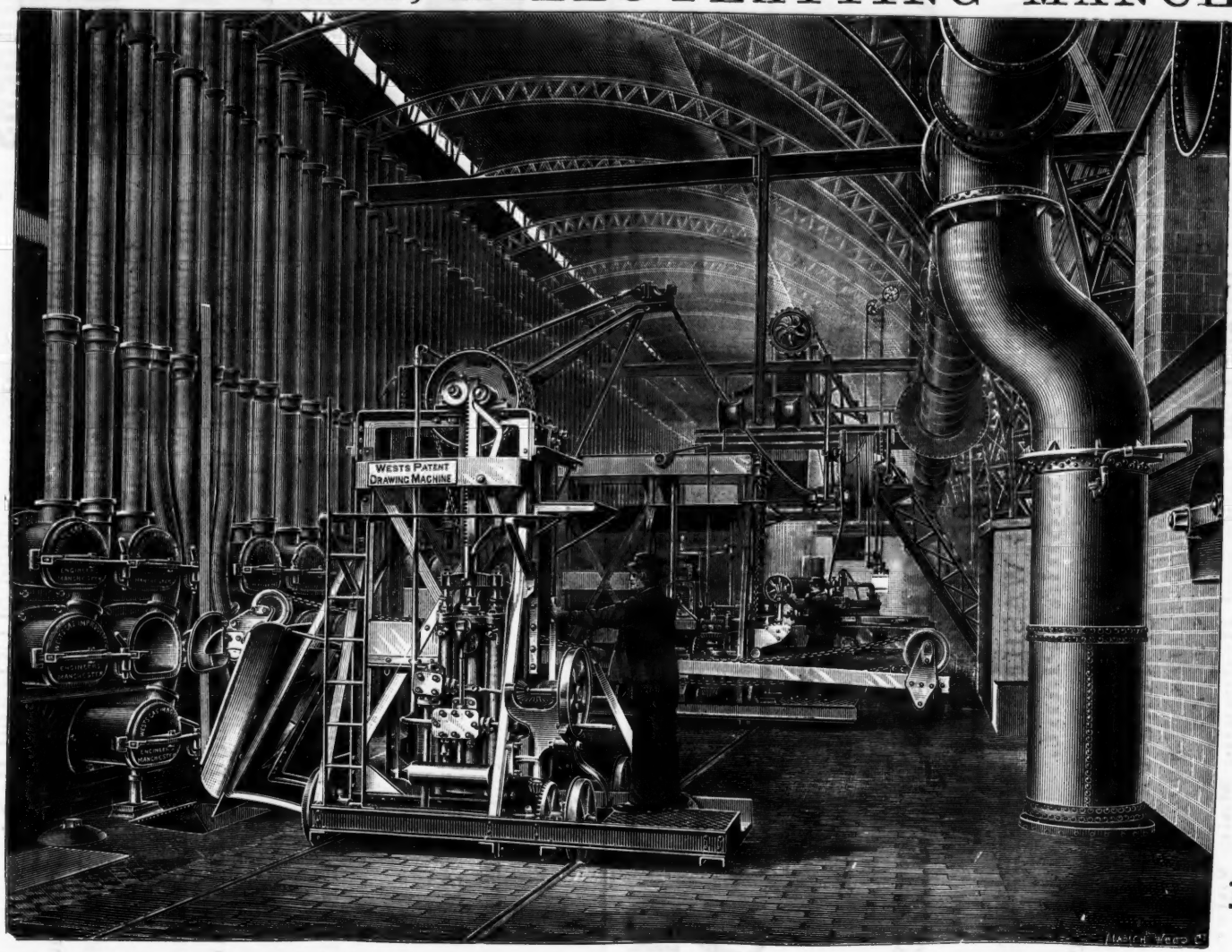

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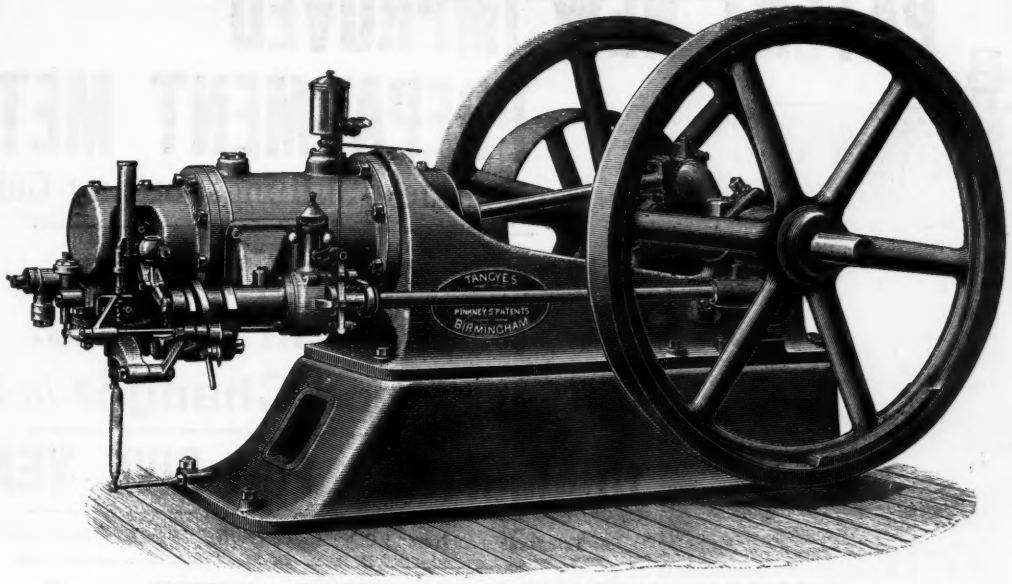

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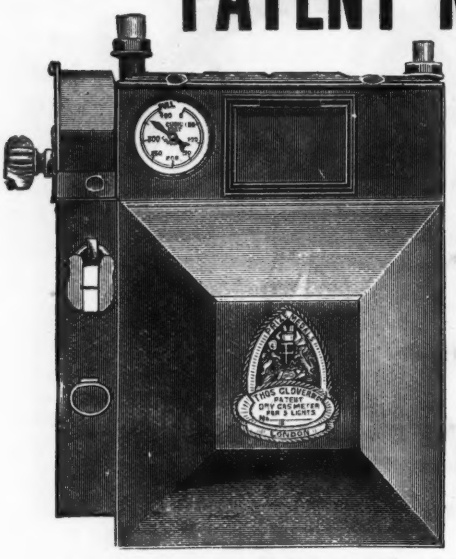

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EDITORIAL NOTES.

Incandescent Gas-Light Litigation.

THE hearing of the long-delayed actions by which the validity of the patents owned and worked by the Incandescent Gas-Light Company is to be tried, commenced on Monday of last week, in the Queen's Bench Court No. 9, by Mr. Justice Wills; and the first instalment of our report of the proceedings will be found in another column. The evidence for the plaintiff Company, much of which is of great interest for gas engineers, was finished on Friday, when the defendants' case was opened by Mr. Bousfield, Q.C. It is at the moment of writing quite uncertain how long the hearing will take. The actions are of the highest importance, both technically and commercially; and they must be regarded as marking an era in the history of the development of gas lighting. We have, of course, to guard against making any statement here that could be construed as a comment on the rights of the matter; but it is permissible to observe, by way of assisting our readers to understand the drift of the first case, so far as it has now gone, that the Incandescent Gas-Light Company are relying upon the first patent of Carl Auer von Welsbach, dated Dec. 12, 1885, which claimed "the manufacture, "substantially as herein described, of an illuminant "appliance for gas and other burners consisting of a cap "or hood made of fabric impregnated with the substances "mentioned, and treated as set forth." The defendants in the first action are the De Mare Incandescent Gas-Light System, Limited, who are raising the whole question of the validity, on various grounds, of the patent in question, as regards its being set up in opposition to their own system, the nature of which has been published in the "JOURNAL" on several occasions—one modification being described in our "Register of Patents" only last week. Mr. Fletcher Moulton, Q.C., leading for the plaintiffs, is attempting to establish the right of Herr von Welsbach to his 1885 patent on the grounds of novelty and utility; and he maintains that, by following the specification, the Welsbach incandescing caps or hoods—usually called "mantles"—can be made satisfactorily. It is also argued that any of the so-called "rare earths" found suitable for manufacturing a satisfactory mantle can be so used, and come within the protection of the patent. So far as the defence has been revealed, it appears to rest mainly upon a denial of the last argument, although certain anticipations are also alleged. The action is being well fought out in "the grand manner," with the aid of strong contingents of experts, and with a display of advocacy of the utmost brilliancy on both sides. When the proper time comes, we shall have something to say respecting the way in which the principal witnesses acquitted themselves. For the present, it is enough to observe that no more instructive case, as regards the development of gas lighting by incandescence, is conceivable as likely to come before the Courts; and to follow the conduct of it is an intellectual treat of a high order.

The London County Council and the South Metropolitan Gas Bill.

IT appears that the Bill of the South Metropolitan Gas Company is not, after all, to be opposed by the London County Council. It has already been noticed here that the Council recently resolved, by a small majority, to adopt the recommendation of their Parliamentary Committee to the effect that the Bill should be opposed; but, in order to give effect to this decision, it was necessary to hold a special statutory meeting of the County Council, under the Municipal Corporations (Borough Funds) Act, to settle not only the question of opposition, but also to decide out of what funds the cost of such opposition should be paid. Usually this statutory provision does not place any considerable check upon the exuberance of the County Council in respect of parliamentary action to further their whims; but last Tuesday the value of the Borough Funds Act was quite unexpectedly exemplified. Contrary to all precedent, the statutory meeting failed to endorse the resolution of the previous ordinary meeting of the Council; and the motion to oppose the Bill was lost for want of an absolute majority vote in its favour. The prescience of the "Progressive" element in the Council was signally illustrated in the discussion that preceded the voting. Sir J. Blundell Maple had spoken in praise of the Bill, on the ground that it seemed to him to be one of the best measures that could possibly be brought forward in the

interests of the consumers and the workmen of the Company. He thought also that it would be a good thing if, as the Bill proposed, gas stocks could be bought by the small investor in £5 parcels. This was, of course, discussing the Bill upon its merits; which is far too common-sense a way of looking at the proposals of a Gas Company to accord well with the workings of the perfervid Progressive spirit. Accordingly, Mr. Sidney Webb is reported to have at once expressed the opinion that not one single member of the Council would object to the opposition to the Bill when its iniquitous character was made known. We do not give this well-informed gentleman's deliverances at length in our report of the proceedings of the statutory meeting, because they were of no permanent value. But it may be observed here that Mr. Webb declared that there is no more cherished possession of the people of London with regard to their gas supply than "the Metropolitan "Gas Act," which the speaker described as the Act that made it obligatory to sell new gas stocks by auction. If the people of London do cherish a particular Act under this name, as Mr. Webb declared, it is rather to be regretted that no such Act actually exists. What the South Metropolitan Bill proposes is not to abrogate, but to carry out, the intention of the auction clauses; but no Progressive could be expected to understand this. Eventually, as already observed, the resolution to oppose the Bill failed, notwithstanding the fact that all the force of the party in the County Council led by Mr. John Burns was exerted in antagonism to the Company.

The Affairs of the Sheffield Gas Company.

THE proceedings at the ordinary meeting of the Sheffield United Gaslight Company are usually of more than local importance; and those which will be found reported in another column are no exception to the rule. The chief source of interest in the contemporary history of this Company lies in the fact that it is an enduring protest against the hasty conclusion that there can be no good gas management under the old-fashioned *régime* of maximum dividends. Here, as a matter of fact, is a Company whose Directors, without the inducement of a sliding-scale of price and dividend, never lose an opportunity for taking something off the price of gas. Maximum dividends, a full reserve fund, and 18-candle gas at prices ranging from 1s. 8d. to 2s. per 1000 cubic feet, constitute a combination which, as the Chairman (Sir F. T. Mappin, Bart., M.P.) claims, is not merely hard to beat, but is actually unrivalled in the history of gas lighting in England. The causes of this brilliant result are to be found in a growing business, a compact district, a low capital burden, and good management. The two latter considerations properly go together, as the last is the prime factor in the case. Where there is good management and wise administration, most other desirable things seem to follow naturally. It would be less than what might be expected of their human nature if some of the inhabitants and ratepayers of Sheffield did not sometimes think how nice it would be if the gas undertaking belonged outright to the town, as is the case with most of the neighbouring manufacturing centres. These people may find solace in the price and quality of their gas supply. It is quite possible that Sheffield might be "improved" at the expense of the gas consumers, if the gas undertaking were a department of the municipal organization. But the lot of the consumers would certainly not be ameliorated by any such change of their circumstances.

The Pecuniary and Personal Interests of Legislators.

WHEN discussing recently the question of the right of shareholders in gas and electric light undertakings who are members of local authorities to take part in the proceedings of these bodies which are capable of being construed as affecting their pecuniary interest in the former, we remarked upon the analogous case of Members of Parliament. A striking instance in point has just arisen in connection with the appointment of a Select Committee of the House of Commons to inquire into the "fair wages" clause in all Government contracts. The Trade Union interest in and out of the House is making a determined attempt to capture the control of the Government stationery and printing work; and it succeeded somehow in getting upon this Committee a number of professed partisans of Trade Union principles. Among these were included Mr. John Burns and Mr. Michael Austin. Objection was at once taken publicly to these members' names, on the ground that the London Society of Compositors contributed to their election expenses, which rendered it at least questionable whether they could act impartially. It appears that Mr. John Burns so far felt the force of the objection as to retire from the Committee; but his Trade Unionist colleague has not yet followed his example. It is evident that here is a case in comparison with which that of shareholding members of local authorities is mild indeed. The incident at the same time shows how difficult it would be to define what and how much personal or pecuniary interest in a subject of legislation or administration should suffice to deter a legislator or administrator from having anything to do with it. We are not at all prepared to advance the opinion that a public man whose election expenses happen to be defrayed by a voluntary subscription is thereby disqualified from acting in any and every matter that may affect one or more of the subscribers. It is far better, and more sensible, to hold that such a man must be the best judge of what course is consistent with his own honour in this as in other respects—subject, of course, to the superior tribunal of public opinion. The great thing to secure in regard to such matters is full and free publicity of all antecedents and circumstances. Where a question of Trade Union tactics is brought before Parliament, it is surely better for recognized, and consequently in a sense authorized, partisans to come out in the open, and do their utmost for their side, than for them to keep in the background, and do their work through the agency of puppets. It is not for us to discuss here the particular issue of the Government printing contracts, beyond noting that the present movement is simply another example of Trade Union arrogance. The rights of the opposition case are stated in a letter of the General Secretary of the National Free Labour Association which appeared in the "Globe" on the 11th inst. According to this statement, the Society men in the London printing trade number about 15,500, while the non-Society men are more than 24,000 strong. It cannot be proved that the latter are, as a rule, worse paid or inferior workmen as compared with the Society men. Indeed, the contrary largely obtains in this as in so many other skilled trades, by reason of the dead level of mediocrity consequent upon the operation of the "Union stroke." It is therefore most essential to the interests of justice that the House of Commons Committee should not be under any Trade Union domination. In no trade is Society organization so facile as in that of printing; and if a majority of those who earn their living in the trade prefer to dispense with the Society's rule, there must be reason for their conduct good enough for Parliament to appreciate.

Unsafe Oil-Lamps.

IT is always a matter of congratulation when one is able to speak well of a public officer; and we are consequently glad at being able to commend the line of action that has been systematically followed by Mr. Alfred Spencer, the Chief of the Public Control Department of the London County Council, in regard to petroleum lamp accidents. There can be no question that the number of fatal accidents, and fires, directly caused by defective or improperly made petroleum lamps is excessively high. Some mishaps of the kind must necessarily occur, so long as humanity is what it is, and lamps and mineral oil are what they are. It has long been notorious, however, that petroleum as a lighting agent is credited with many evils that should really be attributed to the "cheap and nasty" lamps that the law permits to be sold in this land of freedom. English law is nothing if not unsystematic. After many years, we did get an Act of Parliament passed in the interest of public health; but to this day the country lacks one to prevent risks to public security. We have a Petroleum Act which very properly and efficiently safeguards the public from being victimized by those who would otherwise import and deal in unsafe lighting oils. There is also an Explosives Act, which regulates the trade in articles that, by their nature, are likely to "blow up." Yet there is no law to prevent the manufacture in the dwellings of the people of explosives in the form of petroleum lamps which the smallest irregularity in handling or use will convert into agents for spreading death and destruction around them. A short time ago, some associated dealers in mineral oil of naturally high flashing-point tried to convert this matter of lamp accidents to their own advantage by getting

Parliament to raise the flash-point for lighting oil all round. The Control Officer of the London County Council has not been drawn off the true scent by this proceeding. Whatever may be said of petroleum flash-points, it is the means by which the petroleum is used that practically determine its character. Mr. Alfred Spencer is convinced—and he says so in a recently-issued report—that mineral oils such as are now in common use can be safely burnt in properly-constructed lamps; but he also thinks that legislation is necessary to prevent the sale of unsafe lamps. He does not see any other way of compelling lamp manufacturers to make, retailers to sell, and the public to use really reliable lamps in preference to showy articles. As a matter of fact, the public are incurious in this regard—just as they would be with respect to the flash-point of petroleum itself, if there were no statutory safeguard thereanent. Mr. Spencer's point, in short, is that oil-lamps properly fall within the category of those articles of commerce, the quality of which trade principles are insufficient to protect, and which therefore need statutory supervision. He is probably justified in this view. We have no reason to favour in any way the mineral oil lighting industry; but all the same we do not desire to rest upon the continuance of preventible lamp accidents, the claim for the superiority of gas as the light and fuel for the people. The London County Council deserve every credit for their humane endeavours to remove this great and crying public danger of unsafe lamps.

A New Nitrate Combination.

It is reported that a fresh combination of nitrate of soda producers has been effected, which ought to be almost as good news for manufacturers of sulphate of ammonia as for the nitrate interest. At any rate, the working of this new attempt to regulate the productiou of the world's principal source of supply of so-called artificial nitrogenous fertilizing material will be watched from many a gas company's office with unaffected solicitude for its success. It is stated that the agreement is for three years from the 1st prox.; and that it provides for a maximum annual shipment to all countries for this period of about 1,080,000 tons. This, therefore, may be regarded as representing, in the judgment of the experts of the trade, the quantity of nitrate which should satisfy the real needs of consumers. A remarkable feature of the compact is a clause which provides that if during the coming summer the price in Chili for nitrate of ordinary quality should exceed 6s. per quintal, the quantity to be shipped may be increased at the discretion of the Directors. Thus it appears that the agreement is not designed to put an artificial limit to production, or to force up the market price of the commodity to anything like a famine standard. This is further shown by the circumstance that the allotted output is larger than the quantity previously shipped in any one year, not excluding the past year, when importers were supposed to be engaged in ruinous competition. Under these conditions, it is difficult to see what objection could be reasonably urged against the combination. In these columns, at any rate, the idea of regulating production to consumption has never been scouted by reason of the deference supposed to be due to what has been misunderstood as being the teaching of orthodox political economy on the point. If an individual producer is permitted to adapt the scale of his operations to what he feels to be the demands of the market—and nobody has ever denied him this privilege—there can be no sound reason why associated producers subjected to the same influences should not act in the same manner. When a producer cannot help himself in the matter of production, he must needs sell his product for what it will fetch. But this observation, applying as it does in full force to the manufacturer of sulphate of ammonia, does not apply in anything like the same degree, if at all, to the nitrate producer. It is thought that the effect of the arrangement now made will be to prevent nitrate falling during the next three years below 8s. 6d. per hundredweight, at which figure some of the companies who have been compelled to shut down will be able to recommence work with the prospect of earning a small profit; while those who are most favourably situated will be able to maintain their dividends on a smaller output, and thus prolong their existence. Meanwhile, the influence of this improved state of the nitrate market on sulphate can hardly be other than beneficial. With good management, the advantage thus secured ought to be preserved.

WATER AND SANITARY AFFAIRS.

The provisions of the Government Water Bill, which were explained in the statement made by Lord James of Hereford in the House of Lords last evening, correspond very closely to the forecast which we have already discussed. A Water Board will be created, having jurisdiction over the entire area of the Metropolitan Water Supply. Purchase seems to be very distinctly contemplated; and the London County Council will be strongly represented on the Board. A clear stage for the introduction of the Government measure was obtained on Friday, by the postponement until the 24th inst. of the order in the House of Commons for the second reading of the several Water Bills affecting the Metropolis. This arrangement is stated to have been the result of a compromise arrived at, after prolonged negotiation, between Mr. Chaplin and the representatives of the various bodies concerned. Whether any of the London Water Companies were included among these "various bodies," we are not yet informed. That the Companies did not approve of the arrangement, so far as their own Bills were concerned, is evident from the remarks made in the House of Commons by Mr. Boulnois. That the Government had intended to allow the second reading of the Companies' Bills, on the condition that they were referred to a Hybrid Committee, is made evident by the fact that Mr. Chaplin had given notice of an instruction to be given to the Committee concerning the mode in which such Bills should be dealt with. But the President of the Local Government Board found that, while the London Unionist members were strongly opposed to the further progress of the Transfer Bills pending the introduction of the Government measure, certain members who were interested in these Bills—that is to say, the County Council party—emphatically objected to "any differentiation." As a matter of expediency, in order to avoid a "wrangle" in the House, which would absorb time required for other purposes, the Government yielded the point, and lumped all the Bills together. It appears that, on Thursday evening, Lord James of Hereford and Sir Arthur Arnold had a private interview of some length with Mr. Chaplin; and there is no doubt that the Chairman of the County Council did his best to delay the progress of the three Bills of the Water Companies which await their second reading. Mr. Boulnois has warned the House of Commons that, if delay or failure respecting these Bills leads to any shortcoming in the water supply, the responsibility will rest with Parliament. The instruction to be given to the Hybrid Committee ought to have satisfied the direst opponents of the Water Companies; and it is evident that the Government understood the urgency of the case, though forced to yield in order to save the time of the House.

Some information as to the progress of his negotiations with the London Water Companies, with a view to the purchase of their undertakings, was afforded by Sir Arthur Arnold at the meeting of the County Council last Tuesday. According to this statement, matters are still proceeding pleasantly. But to what purpose? Sir Arthur is able to speak in genial and complimentary terms of the Directors; and he expresses a hope that the policy of purchase and transfer will succeed, not only without compulsion, but even without recourse to arbitration. On this point, we observe that the Directors are what they were; the change is with the Council, as represented by the Chairman. Had the Companies been approached in the same conciliatory manner in the past, the Council might have been spared the menace of the Government Bill. Repentance comes too late; and the Council have allowed their chance to pass by. The ex-Deputy-Chairman of the County Council (Mr. W. H. Dickinson), in a letter addressed to "The Times" last week, shows a keen perception of the situation in some respects. He pleads that the Metropolitan Water Supply shall be transferred to the Council, in order that the latter shall not lose any of that "attractiveness" which now attaches to its work. "The "problem of the water supply," he argues, possesses a variety and an interest which have "already attracted the "minds of men of ability;" and Mr. Dickinson is afraid that such men will be lost to the Council unless they are allowed to exercise their superior intellects on the water

problem. It was thus that "the great intellect of Mr. "Chamberlain" was years ago placed at the service of the Birmingham Corporation; and Mr. Dickinson dreads the threatened Water Trust, as likely to "alienate the "assistance of intellectual citizens" from the ranks of the County Council. We may therefore understand that, in pushing their Transfer Bills, the Council are seeking to preserve their intellectual stamina. Perhaps the extent of their representation on the coming Water Board will be a sufficient solace.

The postponement of the second reading of the East London Water (Height of Supply) Bill is a circumstance on which the inhabitants of East London may be distinctly congratulated. These unsuspecting people are entirely unaware of the predicament which the County Council are preparing for them, if only Parliament can be persuaded to pass this seemingly innocent measure. The Bill proposes that the Company shall be compelled, under severe penalties for default, to furnish a constant supply to the tops of the highest houses in the district. But evidence has been given whereby it appears that a good supply of water is already afforded, even where the cisterns are considerably above the statutory level. Parliamentary conditions, carefully laid down and faithfully observed, are now to be set aside; and in order to meet a few isolated cases, which could be otherwise provided for, the supply is to be given at a pressure which will damage and burst a large number of communication pipes and fittings, entailing serious cost on owners and occupiers. Fittings in connection with the domestic water supply in East London are none of the best; and a heavy tax will be put upon the people if effective and substantial appliances are to be substituted, in order to bear an increased pressure for which they have not asked. In short, the Height of Supply Bill appears to furnish an example of the height of absurdity.

The Carburetted Water-Gas Plant at the Brussels Gas-Works.—According to some particulars furnished by M. Aerts, the Brussels Municipal Gas Engineer, to the President of the Belgian Association of Gas Managers (M. Busine), for presentation at the last meeting of the Association, the cost per 100 cubic metres of the carburetted water gas of 24-candle power produced by the plant installed in the Brussels Gas-Works is as follows: Fuel (115 kilos.) for generators and boilers, 1·55 frs.; oil (75 kilos.), 6·53 frs.; lime (20 kilos.), 30 c.; labour, 20 c.; miscellaneous, 15 c.—total, 8·73 frs. The plant is capable of producing from 17,000 to 18,000 cubic metres of carburetted water gas per 24 hours; the make per run being 87 cubic metres. Petroleum of medium quality, between burning and lubricating oil, is employed.

The Cottonwood Water Power and Electric Company, Limited, the prospectus of which will be found elsewhere, has been formed with a capital of £210,000, in £1 shares (divided equally into ordinary and preference), to acquire the waters, waterfalls, reservoir sites, and lands necessary for the operations of the Company, of and in the Little Cottonwood Creek, near Salt Lake City, Utah (U.S.A.), and to erect water-power plant for the supply of electrical current. It is proposed to issue 70,000 preference shares (7 per cent.), and an equal number of ordinary shares; the balance to be allotted to the vendor in part payment of the purchase-money. A contract assignable to the Company has already been secured by him for ten years for the supply of horse power, which is calculated to provide a dividend at the rate of 8 per cent. per annum upon the ordinary shares after the payment of the preferential dividend. The Chairman of the Company is Mr. J. Boustead, a Director of the Lambeth Water Company; and three other members of the Board are Directors of gas and electric lighting companies.

The Commercial Value of Acetylene Gas.—Some important investigations have been carried out in the United States by Dr. Birchmore in connection with carbide of calcium and acetylene gas. He has come to the conclusion that the gas is useless for the purpose of enriching ordinary water gas; but that it is at least equal, and probably superior, to sunlight for purposes of photography. He says no burner now made will consume the gas economically, irrespective of cost; and the invention of a burner with apertures small enough, is the first serious obstacle to be overcome before the gas can be tested in comparison with ordinary illuminating gas. Pure acetylene gas, when burned as an illuminant, makes bright colours brighter and dark colours darker; consequently, it might be used in a ball-room, but not in a library or an ordinary sitting-room. With regard to price, he says that if carbide of calcium can be produced at £9 a ton, or less, acetylene gas can be used commercially in a limited field. It appears that between £5,000,000 and £6,000,000 has been invested in the United States in speculative companies for the manufacture of carbide of calcium and acetylene gas, under the Willson patents.

ESSAYS, COMMENTARIES, AND REVIEWS.

GAS AND WATER COMPANIES IN THE STOCK MARKET.

(For Stock and Share List, see p. 589.)

THE Stock Exchange had another quiet time last week. Business was decidedly restricted; and the tendency either way was not much marked, but ebbed and flowed a little now and then in response to some slight movement. All the speculative quarters kept very still; things not looking promising enough for a *coup*. But the week was saved from being quite devoid of feature by the enormous strength of the gilt-edged luxuries. Money keeps pouring in; and prices are filled up higher and higher. On Thursday, Consols touched 110 *ex div.*; and the Leeds Corporation 2½ per cent. loan was all subscribed at a premium! With such a plethora, ease is not the word to describe the condition of the Money Market; and the requirements for the Stock Exchange settlement were met at very low rates. In the Gas Market, there was a good revival of activity; and the general tendency continued very firm. It is noteworthy that two more stocks—viz., British and South Metropolitan "A"—have quitted the ranks of the 4 per cent. securities, and joined the 3 per cent. and upward division. Gaslight "A" was again an important exception to the rule; and there was a good bit of selling at the reduced figures. The quotation was put down 1½; and it looks very much as if it is going lower. The secured issues, however, were steady enough; but there was not much doing in them. South Metropolitans were uncommonly active; and all three issues improved their positions. The unexpected failure of the opponents on the London County Council of the Company's Bill to secure the requisite majority to oppose it in Parliament had an agreeable influence. Hardly anything was done in Commercials; but a parcel of the old stock changed hands at top price on the closing day. The Suburban and Provincial group continues to show very great strength; anything on offer being readily snapped up. Several have advanced their quotations, as shown in the list. Prices cannot at present be quoted for Croydon Commercials; transactions in the market are infrequent, and the figures last dealt at are incommensurate with the prices realized by the Company for their recent issue of new stock. Among the Continental contingent, Imperial was again a little flat, and lost a couple of points; but Union and European were firm and unchanged. Of the rest, Belgrano, San Paulo, and Oriental have scored further advances. The activity recently displayed by the Water Companies was well maintained last week; and several of them added further to their already substantial gains.

The daily operations were: The Gas Market was lively on the opening day—South Metropolitans being especially active; but prices did not vary. In Water, Chelsea rose 5; and Lambeth, 2. There was rather a lull in Gas transactions on Tuesday; but quotations did not fall, and South Metropolitan "C" moved up 2. In Water, Chelsea and Lambeth 7½ per cents. advanced 3. Business in Gas continued somewhat restricted on Wednesday. South Metropolitan "A" improved 3; and British, ½; but Gaslight "A" declined 1½. Thursday's business was a little more active, mostly in Gaslight "A" at indifferent figures. Oriental £4 10s. paid advanced ½. Things again became quieter on Friday, though South Metropolitan "B" was buoyant, and rose 1. Saturday was unusually brisk; and many changes were effected. Both Alliance and Dublin issues improved ½; Belgrano, ½; and San Paulo, ½. But Imperial Continental fell 2. In Water, New River rose 5; and Chelsea preference, 2.

ELECTRIC LIGHTING MEMORANDA.

A Statistical Table of Electric Light Undertakings—The Accounts of the City of London Company—Electric Supply in Diverse Metropolitan Districts—The Coal Costs of Lighting Stations—Provincial Companies and Corporations.

ANOTHER of the statistical exercises in which our electrical contemporaries so delight, appeared last week in the shape of a supplement to the "Electrician." It consists of a table showing the capital outlay and receipts and expenditure for the past year of a select number of statutory electric supply undertakings in London and the Provinces. Judging from the inquiries we occasionally receive, the organs of the electric lighting industry in publishing these statements satisfy a very generally felt need. It is no depreciation of the value of the table now before us to remark that it is almost as valuable for what it does not, as for what it does, contain. The bashfulness of certain electric supply companies who object to disclose the extent of their business to the public gaze, is doubtless justified by the extreme value to themselves of the particulars kept secret. But enough is known to enable any interested inquirer endowed with a very ordinary amount of perspicacity, to form a pretty reliable idea of the actual state of the electric light industry. The present table gives more or less complete statistical information respecting seven Metropolitan and six Provincial companies, and five Municipal electric light undertakings. Further tables on the same model are promised as additional returns come to hand. The largest concern included in this instalment is the City of London Electric Lighting Company, who have now expended

£1,127,910 upon their venture, and are not at present prepared to state the number of units they sold last year. In point of fact, the accounts of this particular Company appear to have given a considerable amount of trouble to the statistical analyst. Out of the total capital outlay, £243,451 (or 21·5 per cent.) is set down under the head of lands and buildings—a substantial, but, as such concerns go, not an excessively high, proportion. Then "plant"—in which term are included transformers, accumulators, meters, and instruments—stands for £386,348, or 34·2 per cent.; mains cost £338,407, or 30 per cent.; and lastly there comes a portentous entry of £159,703 under the head "miscellaneous," being 14·1 per cent. of the whole.

In the last sum is included, together with lamp-posts, which are used, and telephone tubes, which are not used, heavy charges in respect of salaries, directors' fees, and so forth, which have not been defrayed out of revenue. When he comes to analyze the revenue account of this Company, the statistician is compelled to complain that the figures require considerable adjustment before they can be made in any way conformable with those of other electric light undertakings. For instance, as the Company do not as yet debit their revenue with any charge for repairs or depreciation, it has been necessary to collect the various sums that have been applied to these objects out of the funds derived from premiums on stock issues. In this manner, the total expenditure on revenue account is increased from the £49,329 shown by the account to £61,202. Nor is this all; for certain other large sums expended for repairs and maintenance of mains, machinery, and plant have also to be brought into account. Altogether, though the City of London Company had a revenue last year of £107,321, of which £12,894 was derived from the public lighting, very little (if any) of this handsome income could have been true profit.

Reference has already been made in these columns to the past year's progress of the St. James's and Pall Mall, and the Westminster Companies. Of the other Metropolitan electric supply companies included in the present list, the Charing Cross and Strand Electricity Supply Corporation did the largest business. This, as we have had previous occasion to remark, is, of all the London companies of the same order, the one which possesses the largest share of long night lighting. It serves the great amusement centre, where those people most do resort whose intention is not to "go home till morning." Yet for all this special advantage of position, the Company only earned £28,571 last year. Their trade, moreover, was done at the lowest selling price of all the listed undertakings, as they only took on the average 4·98d. per unit. Curiously enough, their capital outlay per unit sold was exactly the same—3·16s.—as that of the Westminster Company, who sold double the number of units of electricity. The best example of the course of the electric supply business in a good Metropolitan residential district is supplied by the Notting Hill Company. Now, Notting Hill and Bayswater, albeit not first-class London neighbourhoods, are yet of good repute and high rateable value—in these respects equalling, if they do not transcend the best among the residential suburbs of the largest Provincial cities and towns. The Company began to supply in 1890; and consequently they must be esteemed as having had time enough to test the capacity of their district for absorbing electricity. Of their authorized capital of £150,000, it has not been found necessary to spend more than £83 999, which testifies to careful husbanding of resources. Yet the Company only succeeded in selling £6940 worth of electricity, which works out to a capital expenditure of 9·21s. per unit; and to do this they had to spend £4413 on revenue account, including £700 set aside for depreciation. The Company received an average of 9·13d. per unit sold—an abnormally high figure; but then they had to lay out 5·80d. per unit, of which only 0·79d. went for coal. Management of such an undertaking is evidently an anxious, and not a very paying, occupation.

It used to be pointed out that the effective lighting duty of a given weight of coal burnt to generate steam for driving electric machinery, was greater than that of the same weight of coal carbonized to produce gas for consumption by means of ordinary burners. This way of putting the advantages of electric lighting was very pretty, and eminently suited to impress the popular mind. It is true, of course, that all systems of lighting can be referred ultimately to coal; but the cost of coal in the actual working of an electric supply undertaking is a comparatively insignificant item in the total working expenses. It appears from this table that the seven Metropolitan Companies entered in it only paid together £38,284 for their whole coal supply for last year. The coal bills worked out, for the different Companies, from 0·57d. to 1·64d. per unit. The expenses of "management" alone equalled this; salaries and wages again usually equal, and in some cases exceed it. Repairs and maintenance, including depreciation, may run it close. Rents, rates, and taxes ordinarily count for more money. "Generating expenses"—that is to say, the general expenses of the station—have no very close relation to the mere cost of the raw material, or fuel.

The table also contains analyses of the capital and working results of the Hove, Liverpool, Preston, Newcastle, Oxford, and Leeds electricity supply companies; and of the Municipal ventures at Aberdeen, Burnley, Hanley, Hull, and Worcester. The age of the latter class of undertakings is against their offering statistics of special value or interest, with the exception of the last named, which was fully discussed in our columns last week. The capital outlay by the Corporations in question is, moreover, on a comparatively modest scale. There is a high degree of uniformity in the Municipal capital outlay per unit sold in these instances; the highest being 4·27s., and the lowest 3·58s. The Provincial companies, on the other hand, show a wide range of variation in this regard—ranging from 2·5s. at Newcastle to 7s. in the case of Hove. This difference is repeated in the revenue; for whereas the Newcastle Company only received 4·8d. per unit, the Hove Company took 8·3d., and doubtless wished it was more.

METEOROLOGY FOR GAS MANAGERS.

In connection with an inquiry conducted by a United States Special Army Engineer Board into the conditions of stability of bridges of large span, Mr. W. H. Bixby was commissioned to prepare a report on wind pressures as affecting works of engineering construction. This report has been published by the United States Government, and contains some observations of permanent value on the general subject which are deserving of consideration by designers of large metallic and other structures. Mr. Bixby passes in review the history of past experiment and observation; and he draws the inference that, while the wind is known to be far more powerful and also far more variable than it was credited with being in the early days of engineering construction, much uncertainty still exists as to the actual amount of wind pressure that should be provided for in particular instances. The results hitherto obtained from the use of small anemometers of all descriptions are so discordant that more reliable instruments are required before their indications can be much utilized as aids to the accurate determination of actual wind velocities and pressures. So far as instruments are concerned, Mr. Bixby thinks it probable that for every different velocity of the wind there is some ratio of the perimeter to the area of the pressure plate at which the partial vacuum behind it is a maximum. So that, for a given velocity of wind, the pressure per unit of area will be least for both the largest and smallest surfaces, and greatest for some intermediate area. It is considered that we must continue to admit the Newtonian law of variation of pressure with the square of the velocity; but it is evident also that any future change in the old formula will be towards a reduction of the pressure, and not towards its increase.

The extension of wind pressure formulæ to other conditions markedly different from those under which the formulæ were deduced is now pretty well admitted to be unsafe; and consequently the real pressure of wind at high velocities is still a matter of considerable doubt, even upon small surfaces, and still more upon very large surfaces. The best that can be done under such conditions of the problem is to accept provisionally the best established data—checking them so far as is possible with outside collateral evidence; and to stand by these results while endeavouring to secure others more satisfactorily proven. What is now needed is observation of actual wind pressures at high velocities on large surfaces and high structures, with measurements of the actual pressure, or deflection, or oscillation thereby produced, and comparison of these with reliable instrumental records.

When the wind is so cornered that its free escape is impossible—as when it blows into the open end of a shed otherwise closed—then the mass of air thus confined naturally acts as does every fluid similarly circumstanced, its pressure being equalized in all directions and exerted normally against all the confining surfaces. The pressures upon and resistances of spheres, cylinders, cones, pyramids, cups, and so forth, are not well ascertained; the results of different experiments differing sometimes by 50 per cent. of the corresponding normal pressure upon flat surfaces of the same area. In many instances, however, this difference is due to lack of clearness in the statements of the experimenters, some of whom report the total normal pressure upon the surface itself, while others report only such component of the pressure as is parallel to the direction of the wind, and which, therefore, represents the resistance of the surface to the wind's motion. In such cases, it is well not to accept extreme reported values, unless these are established by comparison and close examination. The extent of the sheltering action of one body upon another at its side or behind it, as well as the increased pressure that can be thrown upon one body by the near presence of another body, is also matter of much difference.

Reviewing the records, Mr. Bixby observes that, as to meteorological registers, all maximum wind velocity figures derived from the use of the ordinary rotary cup anemometer prior to 1873, most of those prior to 1885, and even many of later date, should be reduced at least 20 per cent. for 30-mile velocities, and perhaps a little more for higher rates, in order to correct for the now recognized past error in the adopted constant of the apparatus. Even after such correction, all these records may require to be still further reduced 10 per cent., on account of the unevenness of ordinary and high winds, to get at the average wind. But on the other hand, it is to be remembered that all high wind velocities may be subject to repeated oscillations of from 30 to 40 per cent. each way from the average, at half-minute intervals, and sometimes even to

60 per cent. increase for nearly a whole minute. So that it is not unreasonable to take the velocity of occasional gusts to be as high as those shown by the unreduced record of the ordinary cup anemometer (estimating the wind velocity at three times that of the cups), and rate the steady velocity of the same wind as being 70 per cent. of the same records. Again, to allow for the influence of large areas, it is according to Mr. Bixby not unreasonable to assume the actual maximum wind pressure of gusts on structures as not over 60 per cent. of that registered by the ordinary small pressure plate anemometers; the steady wind pressure being taken as not over 36 per cent. of the same figures.

With regard to wind pressures upon solids and curved surfaces, in terms of the pressure of the same wind upon their surfaces normal to the wind, the following expressions are given: On cubes turned either square or edgewise, 90 per cent.; on the side of octagonal prisms, 80 per cent.; on the ends of cylinders of three diameters or more in length, 70 per cent.; on the convex side of cylinders, 60 per cent.; on the convex side of spheres or deep cups, 40 per cent. With regard to the effect of wind upon lattices and gratings, it is to be remembered that the first result of scattering a great number of very small holes over the surface of a large thin plate is to allow the wind to go through in sufficient quantity to reduce the partial vacuum otherwise existing at the back of the plate; thus reducing its total resistance. After this the enlargement of the holes tends merely to change the condition from that of a single large isolated plate to that of a large number of individual small plates touching on two sides only. All things considered, Mr. Bixby thinks it fair to take the effective area of a half-open or very open lattice to be at least equal to the front area of its solid portions, increased by an allowance proportioned to the contiguity of these portions. For very thickly-placed lattice bars, the total resistance of the elevation of the girder may amount to 75 per cent. of the resistance calculated for a plate girder.

It will be seen from the foregoing observations that the whole subject of wind pressures and their effect upon engineering structures, is yet in a nebulous condition. It has therefore occurred to us that gas engineers and managers, whose interest in the question is so direct, might without much difficulty organize themselves into a sort of meteorological club, or committee, with the object of utilizing their engineering and geographical advantages in order to acquire additional information concerning these matters. There are gas-works everywhere; and in every gas-works there is to be found an eligible site for a wind-pressure observatory—namely, on the top of the highest gasholder column. It would not need much trouble on the part of the Council of a national society of gas engineers to make arrangements for the formation of such a committee as we have in view. The selection of instruments, and the devising of a system of recording the results of observation, would not be a difficult business; and the value of careful work done under such auspices would be considerable. The pressure of wind was one of the considerations that served to maintain the now generally discarded monumental style of gasholder guide-framing; and those who set themselves to prove that this style was a mistaken one experienced much difficulty in proving their case, from the general ignorance that prevailed respecting the real stresses and strains which gasholders have to withstand. Although a great change has been wrought in the fundamental conceptions of gasholder designers concerning the function and requirements of guide-framing, this has been done in the absence rather than by the aid of reliable data respecting the facts of wind pressure. Such a shortcoming is not creditable to the gas engineering profession, nor is the position of gas managers in this regard safe. For if Mr. Bixby's testimony is worth anything, it goes to show that local influences are almost everything in determining the wind pressures that may be brought to bear upon lofty engineering structures, such as gasholders. A gasholder which would be perfectly safe in one locality might perhaps be in danger in another; and it is this uncertainty that properly organized and uniformly constituted experimental stations would tend to remove. The suggestion is offered here for what it is worth; but it is a singular reflection that for all the revolution in the practice of gasholder framing that has been effected in recent years, the data of wind stress on structures of the kind remain precisely as they were before anything in the way of reform in this regard was attempted.

If a meteorological club of gas managers were to be formed, the members might correspond with profit upon other questions besides this of wind pressure. The effects of air temperature, humidity, pressure, and so forth, upon many of the operations of gas manufacture, testing, and distribution, would naturally engage the attention of such an organization. The science of these things would, however, grow as the observations came to be recorded and classified. As a matter of fact, there are not a few gas managers who have long made a practice of studying meteorological conditions from the technical standpoint. These, without any departure from, or addition to, their regular work, could form the nucleus of the organization we have in view, which would become an additional bond of union for followers of the profession in regard to which their isolation would constitute a positive advantage. At present, whatever information may be gathered in this regard rests with its collectors; for the occasions for publishing it must be few and far between. This drawback a meteorological committee would soon overcome.

OBITUARY.

Mr. John Lothian Anderson, who was for upwards of 35 years with Messrs. Stephenson Clarke and Co., died on the 8th inst., in his 51st year.

The death is announced of Mr. F. Delmar, the Chairman of the San Paulo Gas Company—a position he had filled since the inauguration of the Company in 1869.

The death is announced of Mr. W. Wright, of Alcester, at the age of 78. Deceased was one of the founders, and the oldest Director, of the Alcester Gas Company.

Mr. W. H. Le Fevre died on Friday, the 6th inst. Deceased was some years ago a member of the firm of Messrs. Ordish and Le Fevre, Consulting Engineers; but more recently he carried on business alone in Budge Row, Cannon Street. He was well known in the gas world, was at one time a Director of the Singapore Gas Company, and was also one of the originators of the Jersey Water-Works. He was founder and President of the Balloon Society; and to this a large amount of the work of his later years was devoted.

PERSONAL.

Mr. J. H. Rider has been appointed, out of forty applicants, Electrical Engineer to the Corporation of Plymouth. Mr. Rider filled a similar position at Bolton.

Mr. G. M. Lawford, Assoc.M.Inst.C.E., of Westminster, has been awarded the premium of £100 offered by the Marlborough Corporation for the best drainage scheme to meet the requirements of the borough; and his will be at once adopted.

Mr. G. Rogers, who for many years assisted Mr. J. Heath in the official work of the San Paulo Gas Company, has been appointed Secretary in succession to that gentleman, whose continued ill-health has necessitated his relinquishment of the duties.

Mr. W. J. Woolley, who for the long period of over half a century has been connected with the Loughborough Gas Company, relinquished the office of Secretary at the close of the past year. The Directors, in their annual report, say they received Mr. Woolley's resignation with much regret; and they express their high appreciation of his services. His successor is Mr. W. F. Beardsley.

Friends of Mr. F. D. Marshall, the Engineer of the Danish Gas Company, will be pleased to learn that the Directors have resolved to present him with an honorarium of £1000, in consideration of his services in connection with the planning and construction of their new works at the Strandvei and Fredericksberg, Copenhagen. They have also expressed their "appreciation of the ability shown by Mr. Marshall in designing these works, and of his great industry and application, as shown by the short period within which the works were erected and taken into use." The completion of the works was noticed in the "Journal" on Dec. 24 last.

Mr. and Mrs. E. W. T. Richmond were recently the recipients of a very tangible proof of the respect and esteem entertained for them by the workmen in the employ of Messrs. Richmond and Co., Limited, of Warrington, in the form of a very handsome silver tea service, suitably inscribed. The arrangements were carried out by a Committee, of which Mr. H. E. Ransome was the Chairman, and Mr. H. P. Hughes the Hon. Secretary and Treasurer; and the presentation was made by the former. Mr. Richmond cordially thanked the employees for the good-will they had manifested towards him; and Mrs. Richmond also testified her keen appreciation of their kindness.

An Electric Lighting Act for Calcutta.—After being under consideration for something like three years, the Calcutta Electric Lighting Act has at length been passed. It is more or less a repetition of the English Act of 1882, with the addition of a few sections taken from some of the Indian Acts. The measure is protective of the undertakers; but it will probably require amendment as far as consumers are concerned; for, according to "Indian Engineering," it is silent on a number of points which will have to be considered hereafter. It seems that, so far, what little electrical work has been done in Calcutta has not been very successful.

Forthcoming Sale of Gas and Water Stocks.—It is seldom indeed that a number of choice gas and water stocks such as those which, as already announced in our advertisement columns, Mr. Alfred Richards will offer for public competition to-morrow at the Mart, are put upon the market; and these rare opportunities only come to investors, as on the present occasion, in the case of death. The list is headed with stocks of The Gaslight and Coke and Commercial Gas Companies; these being followed by stocks of the Hornsey, Lea Bridge, Romford, Tottenham, West Ham, and West Kent Companies. This is a good representative list of Metropolitan and Suburban gas undertakings. Gas and water stocks of the following Companies will also be included in the sale: Enfield, North Camp and Farnborough, Worthing, Barnet, Bournemouth, and West Surrey.

NOTES.

Professor Rowden's Gas-Engine.

At the last meeting of the Glasgow and West of Scotland Technical College Scientific Society, Mr. W. T. Rowden, B.Sc. (Lond.), Professor of Applied Mechanics in the College, read a paper entitled "Notes on a New Gas-Engine." The engine in question is his own invention, and its completion has taken up most of his leisure time during the past three years. In this motor, the whole of the four operations which collectively constitute the "Otto" cycle—viz., drawing in the charge, compressing it, the working stroke, and exhausting the cylinder—are accomplished in one revolution, instead of requiring two revolutions, as in ordinary "Otto" engines. In addition to this gain, there is the further advantage that the suction is shorter than the working stroke, with the result that the products of explosive combustion are expanded to nearly twice the volume of the mixture of gas and air before compression, instead of merely to the same volume, as in almost all ordinary gas-engines. This increase in expansion greatly increases the efficiency of the engine. As is well known, these objects were accomplished by Atkinson, both in his "differential" engine and in his "cycle" engine. Professor Rowden's engine closely resembles the former of these motors, in the fact that it has two pistons working in the same cylinder. The mechanism devised for obtaining these objects consists primarily of the two pistons, the connecting-rods of which are attached to separate cranks; the inner piston being connected with the main crank, and the outer piston with a secondary crank, the pin of which is linked with the main crank. The secondary shaft is parallel to, but displaced somewhat from, that of the main crank; and the differential motion of the engine is brought about by this eccentricity of the secondary shaft. In the course of his description of the engine, Professor Rowden stated that, when it was working at 1¾ brake horse power, the quantity of gas consumed was only about 18 cubic feet per horse power per hour. Professor W. H. Watkinson, M.Inst.M.E., was present at the meeting; and, in the course of some remarks which he made on his colleague's invention, he characterized the results obtained as being highly successful, and heartily congratulated Professor Rowden regarding them.

Coke Breeze Concrete.

In connection with a paper read by Mr. H. T. Hare before the Architectural Association, on the subject of "Municipal Buildings," some interesting observations were made by the author and others respecting coke or coke breeze concrete as a fireproof material. The author strongly recommended the extension of the fireproof construction to the roof as well as the floors; and he declared his preference for the oldest and simplest kind of such construction, consisting of rolled iron or steel joists, from 3 to 6 feet apart, with cement concrete filling covering the joists above and below at least one inch. Mr. E. W. Mountford, in discussing the paper, remarked that he had a partiality for using coke breeze concrete. On one occasion, however, breeze was expensive in the neighbourhood where he was erecting a building; so the builder naturally wrote and told him that he knew from experience that coke breeze was a most inflammable material. He therefore had three specimen pieces made of coke breeze and cement of exactly the same quality and thickness as the floors were to be; and he put the three slabs, which were about 3 or 4 feet square, over a tremendous fire for three hours. At the end of this time, they were absolutely as good as when the fire was lighted, except that about three-quarters of an inch was reduced to a sort of ash, which could be removed with one's finger. It was observed in the further course of the discussion that the London County Council will not now accept breeze concrete as a fireproof floor. Mr. W. D. Caröe, the President, also stated that he had seen coke breeze concrete become perfectly red hot in the fire, just like steatite stone. He did not know whether a material which could get red hot was necessarily a fireproof material; and he hoped Mr. Mountford would continue his experiments with it, and publish the results. In reply, Mr. Hare admitted that concrete made simply of coke breeze and cement is not generally supposed to be fireproof. Indeed, he knew of one case where the workmen on the building used it as fuel. Sand or ballast mixed with the breeze would, he believed, make it quite fireproof. A year or two ago he had some test blocks of breeze concrete made. One was of coke breeze and cement; another, coke breeze, broken brick, and cement; and a third had a small proportion of ballast mixed with the coke breeze. He found that the strongest of the whole lot was a mixture of five parts of coke breeze and one part of ballast to one of cement.

Professor Fitzgerald on Chemical Physics.

In his Helmholtz memorial lecture, recently delivered before the Chemical Society, Professor G. F. Fitzgerald gave an exposition and development of those branches of the work of the late Professor Helmholtz which are related to chemistry, and also discussed several of the much-vexed questions of higher chemical physics. It was observed that, unless the weight of a body alters appreciably as its temperature changes, it is not easy to see how the Helmholtz and Kelvin vortex theory of matter can be true. But the difficulty of determining weights at different temperatures stands in the way of an experimental examination of this point. Many modifications of the vortex theory have been proposed; but the only statement that can be made with certainty is that, whatever the nature of atoms may be, the space between them must be filled with some complicated structure, to account for electro-magnetic actions. The theory of semi-permeable membranes, which is of such importance in certain branches of physical chemistry, is as yet in a very unsatisfactory state; but Professor Fitzgerald thinks there is some hope of extending our methods of "chemical filtration" by means of a set of properly constituted diaphragms, each of which is penetrable by certain classes of molecular groups. It was observed that the application of thermodynamics to chemical investigations is full of pitfalls. The law of the conservation of energy has been often misapplied; and it is not sufficiently realized that the second law of thermodynamics is not strictly applicable to irreversible chemical changes, such as explosions. Professor Fitzgerald also remarked that, while an enormous increase of knowledge has attended the assumption that a substance in liquid solution behaves in some important respects like the same substance in a pure gaseous state, it is a grave error to suppose that the physical conditions of molecules of a substance are similar when gaseous and when dissolved.

British Association of Water-Works Engineers.—We are asked by the Provisional Hon. Secretary of this Association (Mr. R. Macintyre) to mention that a full meeting of the Provisional Committee was held in the Westminster Palace Hotel last Saturday, for the purpose of considering the constitution and the rules. These will shortly be published, when a general meeting of the Association will be announced.

Projected Combination of Gas and Water Undertakings in North Wales.—In another part of the "JOURNAL" will be found the prospectus of the Holyhead and North Wales Gas and Water Corporation, Limited, which has been formed to acquire and amalgamate the gas-works at Holyhead, Llanrwst, Bettws-y-Coed, Menai Bridge, Penmaenmawr, Llanberis, Nantlle, Llanfairfechan, and Pwllheli, and the water-works at Llanberis. The capital is £100,000, in £1 shares, on which it is proposed at present to call up 15s. per share. Subscriptions are invited for 80,000 shares at a premium of 10 per cent.; the remaining 20,000 shares being reserved for issue at par to the shareholders and others interested in the several undertakings to be acquired. A dividend of 6 per cent. per annum for the next three years has been guaranteed upon the paid-up capital.

Phosphoretted Hydrogen in Commercial Acetylene.—Calcium carbide used for the production of acetylene almost always contains, according to the "Journal für Gasbeleuchtung," some calcium phosphide, which liberates phosphoretted hydrogen when the carbide is brought into contact with water. It may be recognized by its characteristic smell, or converted into phosphoric acid by passing the gas through bromine water. The amount of the hydrogen in the gas is stated to be about 0·03 per cent. by volume. It appears from experiments by Gréhant that pure acetylene is comparatively innocuous when inhaled in fairly large doses, but that commercial acetylene is frequently made from impure calcium carbide, and is by no means so harmless. The carbide often contains both sulphide and phosphide; and the acetylene obtained has then a most offensive odour.

The Mounting of Incandescent Gas-Burners.—It has frequently been asserted that a very serious drawback to the adoption of the incandescent gas system for public lighting is the damage caused to the mantles by the vibration resulting from the vehicular traffic. A system of mounting the mantles has, however, been devised by Mr. Thomas Redman, of Bradford (described in our "Register of Patents" on Dec. 3 last), by the adoption of which it is claimed this defect has been remedied. At any rate, the system has been tried at Bradford and also at Shipley; and the published results are greatly in its favour. In the latter part of 1894, a trial was made at Bradford with 18 incandescent lights, fixed in six of the large Bray lamps; and in one month no less than 68 mantles were consumed, even with the renewals at less frequent intervals than was really called for. This unsatisfactory result led to a condemnation of the system by the Gas Committee of the Corporation. This, however, did not deter them from instituting another trial early last year, only this time they adopted Mr. Redman's mountings, which were then publicly tried for the first time in Great Britain. The outcome of nine months' working was a reduction in the mantle account to less than one-seventh of that of the first trial. In a report presented to the Committee by Mr. Redman, he shows a net saving of £1 7s. 11d. per lamp by the adoption of his system of incandescent lighting, or £1117 for the 800 Bray lamps in use in the borough, with very nearly 100 per cent. increase in light. With regard to Shipley, the Clerk to the District Council (Mr. J. S. Rhodes) has just reported to Mr. Redman upon a trial of incandescent lighting extending over three weeks, ending on the 11th inst. Five lamps were fitted with burners—one with a single light, and the rest with two lights—two of the latter and the single light being upon Mr. Redman's system. These three lamps stood the trial successfully; whereas the other two required in one case seven mantles, and in the other six mantles and chimneys.

TECHNICAL RECORD.

RESEARCHES ON THE COMBUSTION OF ILLUMINATING GAS IN COOLED FLAMES AND GAS MOTORS.

By Dr. F. HABER and A. WEBER.

(*Continued from p.* 511.)

II.—*Fractional Combustion.*

Fractional combustion would present, as Hempel has stated, a means of separating gaseous mixtures, if the single combustible gaseous constituents can be successively burnt out. This burning-out naturally must begin with the hydrogen, which is treated before carbonic oxide and hydrocarbons, owing to the lower temperature at which it unites with oxygen in the presence of platinum and palladium. Besides hydrogen, carbonic oxide was to be expected as an incomplete combustion product, as these two have been proved by Professor Smithells and others to be the typical products of incomplete combustion. It therefore had to be ascertained first of all if hydrogen could be fractionally burnt out from its mixture with carbonic oxide, which would not appear to be possible according to an observation by Philipps. He states that though carbonic oxide when alone in air over palladianized asbestos oxidizes above 300° C., yet in the presence of hydrogen, it will yield carbonic acid below 100° C. E. von Meyer's observations do not bear on the precise point in question; and Taylor's, so far as they bear on it, show that carbonic oxide, coal gas, or ethylene diminish the action of platinum sponge on detonating gas with which they are mixed. Henry found that carbonic oxide was somewhat oxidized over platinum sponge when mixed with detonating gas, but that it impeded the activity of the oxidation of the hydrogen; oil gas behaved similarly, but to a less degree; while methane scarcely affected the action. Our experiments show that Philipps's results are correct; but they are not exhaustive. Carbonic oxide and hydrogen, whether diluted or not, cannot be fractionally burnt, either over platinum or palladium. Hydrogen, indeed, lowers the temperature of combustion of carbonic oxide; but conversely the latter raises that of hydrogen. Hydrogen when mixed with carbonic oxide remains unconsumed at temperatures at which it would, if alone, be oxidized through platinum or palladium. The two gases together begin to burn at a temperature which is higher as the ratio of the hydrogen to the carbonic oxide diminishes, and lower as it increases. With small quantities of carbonic oxide, therefore, carbonic acid is formed at 100° C., as Philipps observed. For the same ratio of hydrogen to carbonic oxide, the degree of influence exerted by the two gases varies with their partial pressures. In mixtures rich in them, the ratio of hydrogen to carbonic oxide necessary to considerably raise the temperature of combustion of the hydrogen may be 40. In poorer mixtures, the ratio must be lower. Even 0·03 per cent. of carbonic oxide alters so considerably the temperature of combustion of 0·1 per cent. of hydrogen, that this alteration may be used to indicate carbonic oxide. The combustion of a mixture of carbonic oxide and hydrogen is only partial at the temperature at which it commences; and only a portion of the gases is burnt. If the temperature is raised, greater quantities burn; and as the temperature increases, the hydrogen takes part in the combustion in greater percentage than the carbonic oxide. But the last remnants of hydrogen only burn when heated so highly that the carbonic oxide is wholly, or nearly wholly, burnt also.

Therefore a successive burning-out of the constituents of a mixture of hydrocarbons with hydrogen and carbonic oxide is impracticable; and all that can be done is to separate gases which remain unchanged on the complete combustion of carbonic oxide and hydrogen. This method was used as a means of separating carbonic oxide, hydrogen, and methane when greatly diluted. These gases were prepared as follows: Hydrogen, either electrolytically, or from zinc and sulphuric acid with a little copper sulphate. In the latter case, it was washed in concentrated neutral solution of potassium permanganate. Carbonic oxide, from potassium ferrocyanide and sulphuric acid. Foaming is avoided by adding the powdered salt to nine times its weight of the concentrated acid. The gas was purified by passing through an emulsion of ferrous hydrate in solution of potash, and was stored over it. Methane, from zinc dust and chloroform, or from methyl iodide by Gladstone and Tribe's copper-zinc couple. The gas in either case is washed with olive oil, and then very thoroughly with water.

These gases were stored in small holders, and analyzed for their purity. For separate tests, they were passed into an experimental holder, diluted and thoroughly mixed with some air, and the mixture then analyzed. The gaseous mixture from the experimental holder was led to the first combustion apparatus, either directly through a large Winkler's absorption apparatus charged with solution of potash, or through a drying apparatus also. The combustion apparatus consisted of a glass tube—of which the shape and contents could be varied—which was heated to 100° in a water bath, to 300° in a paraffin bath, or to 500° in a bath of sodium nitrate. Boiling aniline, chinoline, and sulphur gave the temperatures 179°, 234°, and 448° C. respectively. A Victor Meyer toluol bath, without air-channel, filled with paraffin, was used for aniline and chinoline. The combustion apparatus was placed in the paraffin or in the vapour of the boiling sulphur. The moisture formed in the apparatus was either shown by an indicator or estimated in a weighed sulphuric acid and phosphorus pentoxide apparatus. The indicator used was a mixture of powdered potassium ferrocyanide and powdered iron-ammonia alum—both freed from water. This indicator turns blue when 50 c.c. of air saturated with moisture at 20° C.,=0·00084 gramme of water, is led over it. Dehydrated copper sulphate under similar conditions showed a less distinct blue coloration. When little hydrogen was present in the gas, the amount of water formed was determined exactly by weighed absorption bulbs. Carbonic acid was removed quantitatively by the train of apparatus already described; qualitatively, by lime water, of which only a small quantity must be used at a test, as freshly precipitated calcium carbonate dissolves according to Fresenius to the extent of 60 mg. per litre of water. On prolonged boiling, calcium carbonate is dissolved in water to the extent of 34 to 36 mg. per litre according to other authorities. Taking this amount, the carbonic acid formed by the combustion of 1·5 c.c. carbonic oxide would cause no turbidity in 100 c.c. of lime water. Therefore the combustion of a trace of carbonic oxide is apt to be overlooked if more than 3 c.c. of lime water is used. The completeness of the combustion was checked by passing the re-dried gas through a second highly-heated combustion tube (platinized asbestos), and collecting any water or carbonic acid formed in the same way as before.

Preliminary Tests.

A U tube, of 1⅜ inches inside diameter, had the lower portion filled with platinized asbestos, and was then suspended in the water or paraffin bath. Pure carbonic oxide and commercial hydrogen were used in the tests. (1) 15·5 per cent. of carbonic oxide in dry air was oxidized feebly at 224° to 227·5° C.; more actively at 235° to 236° C.; and wholly at 275° to 280° C. Glowing was prevented by passing the gas at the rate of 0·5 c.c. per second. Before each test, time was allowed for the temperatures of the bath and the asbestos to equalize themselves. The same gas, when moist, oxidized badly at 220° C., and actively at 230° C. and upwards. (2) 8·6 per cent. of hydrogen in air underwent combustion at 82° to 90° C. when damp, and at 64° to 69° C. when dry, except for traces, which were possibly to be ascribed to a small quantity of hydrocarbons in commercial hydrogen. 13·7 per cent. of hydrogen began to oxidize at 35° to 37° C., with gentle glowing of the asbestos. (3) 5·2 per cent. of carbonic oxide and 3·4 per cent. of hydrogen, in dry air, formed at 200° C. neither carbonic acid nor water; but both were produced at 207° C.—the combustion taking place with a slight explosion. (4) 15·5 per cent. of hydrogen and 7 per cent. of carbonic oxide, in dry air, at 165° C. burnt in the same manner as the last sample. (5) 8·6 per cent. of hydrogen and 0·6 per cent. of carbonic oxide, in dry air, began to burn at 120° C. without explosion, but with glowing. (6) 8·6 per cent. of hydrogen and 0·1 per cent. of carbonic oxide burnt in the same manner as the last sample, when dry, at 52° to 53° C.; when moist, at 67° to 70° C. With this degree of dilution of the carbonic oxide, the lower limit, from which passing upwards a proportion of carbonic oxide raised the temperature of combustion of 8·6 per cent. of hydrogen, was attained. The explosive commencement of combustion with higher proportions of carbonic oxide is certainly noteworthy. Philipps laid stress on the fact that a slight superheating of the catalytic metallic platinum above the point of combustion would not suffice to cause an explosive-like oxidation. When the combustion begins, a sudden considerable change of state in the relations of the four substances—carbonic oxide, hydrogen, oxygen, and platinum—must take place, or the temperature of the commencement of combustion could not coincide with that of explosive oxidation.

The Tests Proper.

Pure hydrogen and pure carbonic oxide were used. 4·94 per cent. of hydrogen in air began to burn when moist at 45° to 50° C., in six out of ten tests; when dry, at 67° to 70° C. On admixture of 0·1 per cent. of carbonic oxide, it burnt when moist at 75° to 80° C.; when dry, at 100° to 120° C. Palladium was then substituted for platinum. At first, wire containing 1·4 per cent. of platinum and 0·4 per cent. of iron and other impurities was used; but afterwards pure palladium wire. There was, however, no distinction between them in their behaviour towards the gases. Diluted gases were used, so that the heating power per unit volume was very low. The observed relations of carbonic oxide, hydrogen, oxygen, and palladium remained unaltered by all these precautions.

The palladium, when put into a U tube gave, like the asbestos, too brief a contact with the gas, and incomplete combustion at 300° C. Then 21 inches of the palladium wire was folded, so as to give 7 inches of three-fold wire; and this was inserted in a glass tube of ⅛ inch internal diameter. The tube with the contained wire was then bent into a coil of 3½ turns in the flame. The gas, previously heated to the temperature of the bath, then passes over the wire in the coiled tube. If the wire turns green through oxidation, it may easily be reduced by passing hydrogen through the warm tube; and 1·1 per cent. of hydrogen in dry air was completely consumed at 350° C. in this tube.

In a 5½-hour test, 0·0647 gramme of water was formed in this combustion coil, and 0·0045 gramme in a Drehschmidt capillary tube which followed it. With 0·8 per cent. of hydrogen, in dry air, at 165° to 175° C., a 5-hour test gave 0·0580 gramme of water

from the coil, and 0·0078 from the Drehschmidt tube following it. With about 0·1 per cent. of hydrogen, in dry air, at 177° to 178° C., a 9-hour test gave 0·0197 gramme of water from the coil, and 0·0045 gramme from a platinized asbestos tube following it. The combustion was evidently not quite complete in the coil in the last two tests; and therefore a new coiled tube was tried, with air containing about 0·1 per cent. of hydrogen. The coil collected 0·0188 gramme of water; and a platinized asbestos tube following, 0·0003 gramme. Dry air containing 0·97 per cent. of carbonic oxide, passed for several hours through these coiled tubes at 170° to 175° C., into 3 c.c. of lime-water, produced no trace of cloudiness in it. Thus hydrogen was completely burnt in one of the coiled tubes, and for the most part in the other, at a temperature at which carbonic oxide was unaffected. In a fourth test, 0·88 per cent. of hydrogen and 0·97 per cent. of carbonic oxide, in dry air, were slowly led through the first coiled tube into water and carbonic acid absorption vessels; and then, in a second combustion tube filled with platinized asbestos, were heated to a red heat. From the weights of water and carbonic acid found after the second combustion tube, it was found that the ratio of hydrogen to carbonic oxide was unchanged by passage through the coiled tube. A fifth test on the same gaseous mixture, lasting six hours, and with the coiled tube at 177° C., gave 0·0085 gramme of carbonic acid and 0·0058 gramme of water after the coil, and 0·3684 gramme of carbonic acid and 0·1334 gramme of water after the second combustion apparatus. From this, the rise in the temperature of combustion of hydrogen brought about by the presence of carbonic oxide is very marked. A sixth test, in which air containing 0·1 per cent. of hydrogen—such as had been employed in the second test of this series—was used, with the addition of 0·03 per cent. of carbonic oxide, showed that the greater part of the mixture was completely oxidized at 177° C.—the temperature at which the hydrogen is completely burnt in the absence of carbonic oxide. The quantity of hydrogen unburnt was, however, sufficient to indicate clearly the retarding influence of the carbonic oxide.

To render these observations of use in the determination of carbonic oxide in the exhaust gases from motors, it must be ascertained that other gases do not exert any influence. The gas may contain, besides hydrogen, small traces of acetylene and some methane. It is improbable, but not inconceivable, that ethylene may be found in small amount. It is well established that methane does not affect the combustion of hydrogen. The case of ethylene was tried experimentally on a mixture of 0·2 per cent. of ethylene and 0·1 per cent. of hydrogen, in air; and the weights of water and carbonic acid found after the platinized asbestos combustion tube, almost exactly corresponded to those required for ethylene. Therefore the hydrogen appeared to have been wholly consumed previously in the coiled tube. The weights of carbonic acid and water after the latter, showed that a small portion of the ethylene was burnt along with the hydrogen. Philipps found that ethylene burnt over platinum wire at temperatures from 200° to 300° C.

A further experiment showed that a separation was not practicable by taking out from the gas the whole of the hydrogen, with a portion of the carbonic oxide. With 0·8 to 0·9 per cent. of carbonic oxide and 1·0 to 1·1 per cent. of hydrogen, according to analysis, combustion at 348° to 367° C., in an experiment lasting six hours, gave weights of carbonic acid and water from both sets of apparatus, corresponding to 0·8 per cent. of carbonic oxide and 1·1 per cent. of hydrogen. The hydrogen had been rather more strongly oxidized than the carbonic oxide; but it was not completely eliminated.

It only remained, therefore, to separate hydrogen and carbonic oxide with one another from the methane. Several litres of air, containing 3 per cent. of methane, were passed in a slow stream through the coiled tube, heated in the vapour of boiling sulphur; but they produced no trace of turbidity in lime-water. On the contrary, carbonic oxide and hydrogen mixed gave the following figures: About 1 per cent. of hydrogen and 2 per cent. of carbonic oxide gave weights, after the two combustion tubes, corresponding to 0·84 per cent. of hydrogen and 1·77 per cent. of carbonic oxide. Another test gave weights corresponding to 1 per cent. of hydrogen and 1·80 per cent. of carbonic oxide. A third determination on the same sample, gave weights corresponding to 0·7 per cent. of hydrogen and 1·6 per cent. of carbonic oxide. A sample containing about 0·25 per cent. of hydrogen and 0·25 per cent. of carbonic oxide gave weights showing 0·34 per cent. of hydrogen and 0·3 per cent. of carbonic oxide. The experiments show that the quantities of hydrogen and carbonic oxide remaining unconsumed are very small—in the most unfavourable case, amounting to 2 per cent. In the experiments that were carried out afterwards, only gases with 0·33 per cent. or less of carbonic oxide were examined; and therefore the quantity possibly escaping consumption (0·0066 per cent. of carbonic oxide) is infinitesimal.

(To be continued.)

Boiler Inspection and Registration.—A Bill was introduced into the House of Commons last week to provide for the inspection and registration of boilers.

The Denayrouze System of Lighting.—Companies have been formed with capitals of 2,500,000 frs. each, for working the above-named system in France and her colonies and in Italy.

THE EFFECT OF HEAT ON THE ILLUMINATING POWER OF COAL GAS.

In the "JOURNAL" for Jan. 7 (*ante*, p. 13), we noticed briefly a paper read by Mr. Wilfred Irwin, F.C.S., before the Manchester Section of the Society of Chemical Industry, dealing with the subject of the effect of heat on the illuminating power of coal gas, and its relation to the theory of flame. The following is the text of the paper, which appears in the current number of the "Journal" of the Society:—

You may remember that in my last paper* I demonstrated to you the fact, which I believe I was the first to point out, that, when used in conjunction with the same gas, different enrichers do not give the same comparative results with different burners. Thus, suppose we take hydrogen and benzene with the union jet, hydrogen and pentane with the union jet, hydrogen and benzene with the argand, and hydrogen and pentane with the argand, it is readily seen how much greater influence the argand burner has in increasing the illuminating power of the pentane flame than the benzene flame. The converse I also showed to be true—viz., that the same enricher with the same burner will yield different results with different gases. Thus, benzene added at the rate of 1 gallon per 10,000 cubic feet of a 15-candle gas composed of disillumined gas *plus* benzene will give an addition of more than 3 candles with the argand burner; while with ordinary 15-candle coal gas, a result of barely half this amount would be obtained.

With the object of accounting for these phenomena, I have made the following experiments.

A wrought-iron 1-inch pipe, 4 feet in length, was placed in a furnace in a horizontal position in such a way that the central portion only was heated. One end was connected with a supply of ordinary Manchester gas; the other, by means of an india-rubber tube, to a glass vessel, through which the gas had to pass on its way to a burner—the ordinary union jet being the one employed. A stream of gas was now slowly passed through the pipe, while the temperature of the furnace was gradually raised; and a light having been applied to the burner, the action on the flame was carefully watched. Up to a dull red heat, no alteration whatever in the flame was observable; at a medium red heat, the illuminating power of the flame just began to give way. Another slight increase caused it to decline rapidly; and, in fact, it soon fell to below 1-candle power. No smoke was to be seen in the glass vessel between the pipe and the burner; nor, on looking down the former while the gas was passing, was any luminous glow visible, and only a slight deposit of carbon was formed on the side of the pipe. The temperature at which this change in the gas occurred was determined by the Siemens method, and found to be 830° C. This figure is probably a little below the mark; but I think we may safely say that the temperature at which gas becomes practically non-luminous with the union-jet flame is somewhere between 850° and 900° C.

The resulting feebly luminous flame plainly shows stratification into five distinct layers—viz., (1) The lower non-luminous layer. (2) The lower luminous layer. (3) The middle non-luminous layer. (4) The upper luminous layer. (5) The upper non-luminous layer. On proceeding with our experiment and gradually raising the heat of the furnace, the luminous portion became gradually fainter, and the upper non-luminous layer increased in extent. Fumes of smoke began to be visible in the intervening glass vessel, and at the same time the last remnant of the old luminosity disappeared; but in its place rays of luminous specks, due to particles of ignited carbon issuing from the jet, gave a certain amount of light to the flame.

Other experiments were made with mixtures of hydrogen and benzene and hydrogen and pentane, with the result that these mixtures were both found to lose their luminosity at about the same temperature as ordinary Manchester gas. I next varied the experiment; and instead of cooling the gas between the heated portion of the pipe and the burner, I had a diminisher screwed on the end of the pipe, fitted the burner into it, and arranged my furnace so that the main part of the heat should play right on the end of the pipe. By a suitable arrangement, the gas-flame itself was protected from the fumes and light of the furnace, so that the action of heat on the gas could be readily observed.

Just at first, after a light was applied to the gas and the furnace kindled, the flame appeared to increase a little in brilliancy; but it soon again began to fall as in the previous experiment. At a bright red heat, the stratification became again apparent; and the two bright layers, with the dark line separating them, instead of gradually fading away as in the first experiment, began to draw nearer to the orifice of the burner, until at last, at an almost white heat, they came in contact with it and one after another disappeared—the flame being again rendered slightly luminous by the red-hot particles of carbon issuing from the burner.

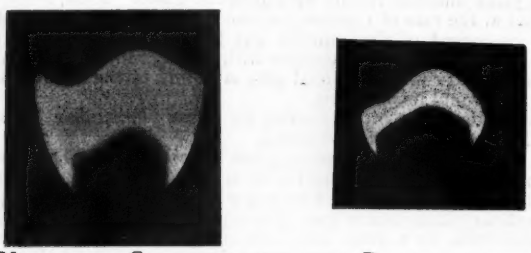
[Before commenting on the foregoing results, the author performed some experiments with mixtures of pure hydrogen with acetylene and pure hydrogen with benzene, in varying proportions. When the proportions of acetylene and benzene were

* See "JOURNAL," Vol. LXVI., p. 138.

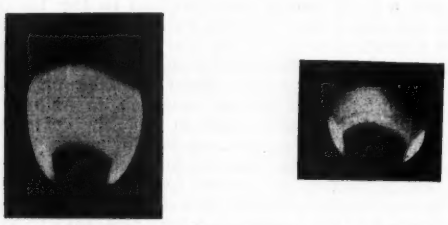
so reduced that the two flames were only slightly luminous, the flame became stratified, and the five layers previously referred to were apparent.]

The experiments described lead to the following conclusions:—

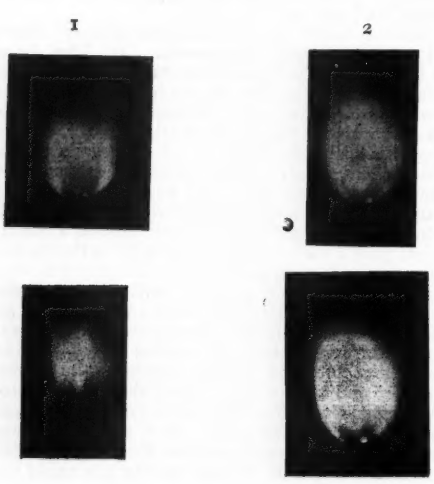
1.—The fact that the passage of ordinary coal gas, or of a mixture of hydrogen and benzene, through a red-hot pipe reduces enormously the illuminating power of the gases without production of soot, and of only a slight carbon deposit in the heated pipe, shows clearly that decomposition takes place of benzene into other hydrocarbons which have not the same ability to form luminous products of decomposition as benzene has. It also explains why the argand burner shows lower results with a gas rich in benzene than the union-jet burner. The greater heat of the argand burner evidently acts in the same manner on part of the benzene in the gas as does the red-hot pipe; thus decomposing it before sufficient oxygen can come in contact with it to produce further decomposition into carbon and hydrogen. It is evident, from what I have said, that it is only when the temperature of the flame is below 900° C. that benzene can be of much assistance in increasing its illuminating power. This action of heat on benzene, &c., also accounts for the fact that one often cannot get the full initial value of different enrichers when added to a gas at the same time.



MANCHESTER GAS BEFORE AND AFTER PASSING THROUGH RED-HOT PIPE.



BENZENE + HYDROGEN GAS BEFORE AND AFTER PASSING THROUGH RED-HOT PIPE.



PHOTOGRAPHS OF FLAME OF ORDINARY GAS ISSUING FROM THE BURNER AT A VERY HIGH TEMPERATURE; NO. 4 BEING THE HIGHEST.

2.—In my second experiment, when the burner was placed in the hottest part of the pipe, the increase at first in the illuminating power of the flame was due no doubt to that which gives the argand burner its superiority with ordinary gas. Less heat being lost by radiation, a smaller quantity of hydrocarbons is required for combustion in order to maintain the heat of the flame. The presence of sparks of incandescent carbon at a temperature of 1100° to 1400° C. shows that a certain amount of ultimate decomposition is now taking place inside the pipe. The gradual approach of the various layers in the feebly-luminous flame to the orifice of the burner as the temperature of the gas issuing from the pipe rises, shows that the position of these layers is chiefly one of temperature; and by determining the temperature of the gas before leaving the pipe, the heat of the flame at the points of the various layers could be approximated.

3.—Having previously shown that the upper luminous layer in these feebly-luminous flames is due to the presence of marsh gas, there can be no doubt that this gas is one of the products of decomposition in the hydrogen with benzene and hydrogen with acetylene flames I have exhibited. What the other products of decomposition in the benzene flame are, and those which enable it to act as so high an enricher, it is difficult to say. Free acetylene it cannot be, as this substance, when diluted with hydrogen, is far less powerful as an enricher than benzene itself; and it also requires, in such a diluted form, a far higher temperature for its decomposition (according to Professor Lewes's theory) than it could possibly get in the lower part of the flame. It may possibly be that, immediately on formation, acetylene is able to decompose at the same temperature as when pure—*i.e.*, about 800° C.; but this has not been proved.

Benzene itself is not an endothermic compound; therefore simple decomposition into carbon and hydrogen would not be likely to produce luminosity, as in the case of acetylene. From my experiments with the heated gases, I have come to the conclusion that the intrusion of a certain amount of oxygen is required to split up the benzene molecule; the products of decomposition being marsh gas, carbonic oxide, and solid carbon—the last raised momentarily, when in a nascent state, to a high temperature by its approach to the hot mantle which, as Professor Smithells recently showed [*ante*, p. 74], surrounds every flame.

Since a flame produced by burning a mixture of hydrogen and acetylene also exhibits stratification, it is clear that the question of the cause of luminosity cannot admit of the simple solution put forward by Professor Lewes. Here, as in the other cases, luminosity is produced by two different reactions occurring at different levels and different temperatures; and much more labour will be required before any clear light on the subject is obtained.

The whole question of flame luminosity is very involved; but if the solid carbon theory be the true one, why do not the particles of solid carbon issuing along with the gas from the highly-heated pipe yield an illuminating effect equal to, or even greater than, that of the gas when burnt in the usual manner?

Leaving matters of purely scientific consideration, let us consider what light, commercially speaking, can be gathered from the experiments I have described. The temperature at which I have shown ordinary gas loses most of its luminosity is less than that of all gas-retorts towards the end of the process of carbonization. When a retort is first charged, it is absolutely necessary to keep the furnace at a very high temperature in order to obtain the best result in gas. Towards the end of the process, however, this is not the case, as less heat is lost by evolution of gas; and may not the low quality of the gas then produced be largely caused by the overheating of the slow current generated at the time?

It has been suggested by White to pass water gas through the retort as the charge is nearing the finish, in order to reduce the temperature. I am unaware of this having been worked successfully on a commercial scale; but there is no doubt that water gas so treated would require less oil enrichment to bring it up to a given standard of luminosity.

Before concluding, I should like to refer to another point bearing upon this matter, and that is the question of the standard burner. When coal gas only was manufactured, this was not so important; but now that oil gas, &c., have entered the field, and comparisons have to be made, surely some more logical standard than the argand burner (which, as I have previously shown, is much more sensitive to one enricher than to another) could be adopted. We have superseded candles at one end of the bar of the photometer; and surely it is far more important to have a truer standard burner at the other. Advocates of other systems of lighting are not slow in finding out the defects in our present method of testing, and are inclined rather to overstate the differences than otherwise; and, for the sake of consumers, it is very important that a satisfactory settlement of the question should be arrived at.

A New Coal-Field in North Nottingham.—An important scheme of coal mining is now engaging attention on the eastern verge of the great Nottinghamshire estates known as the Dukeries. The Wigan Coal and Iron Company are entering upon a 99 years' lease of the minerals underlying the Duke of Newcastle's estate—an area of 33,000 acres; and, according to present intentions, their first pit is to be sunk at Haughton Decoy—a hamlet consisting of several scattered farms situated within the parish of Walesby, nearly four miles to the north-west of Tuxford Station on the Great Northern Railway, and about a similar distance from Earl Manvers' seat at Thoresby. Should the promoters' best anticipations be realized at Haughton, that colliery will, in due course, be succeeded by others on this part of the Duke of Newcastle's estate. Altogether five are talked of; and the second will probably be at Manton, a couple of miles on the east side of Worksop, and close to the Manchester, Sheffield, and Lincolnshire Railway.

NEW ENGLAND ASSOCIATION OF GAS ENGINEERS.

Annual Meeting at Boston.

The Twenty-sixth Annual Meeting of this Association was held on the 20th and 21st ult., under the presidency of Mr. C. D. LAMSON, of Worcester (Mass.). There was a good attendance of members; and the preliminary business included the election of six active and five associate members.

The President delivered an Inaugural Address. He said that during the past fall and winter, general business had been slowly but steadily assuming its normal shape; and in this, according to advance sheets of the Gas Commissioners' report, the demand for gas was advancing. The report stated that the increased consumption in 1895 was the largest of any year since the returns had been made, and that the price had been lowered in fourteen towns. The average price for the last ten years was as follows: 1886, 7s. 2d.; 1887, 6s. 11d.; 1888, 6s. 6d.; 1889, 6s. 0½d.; 1890, 5s. 9½d.; 1891, 5s. 5½d.; 1892, 5s. 9d.; 1893, 5s. 3½d.; 1894, 5s. 3d.; and 1895, 5s. 2½d. Commenting on this increase, he pointed out that the periods of depression were just the times when materials and labour were cheap, and gas companies could enlarge and extend their plant on the best terms. But frequently the expenses were cut down directly the revenue fell off; and consequently when more prosperous times came, the gas companies were not in a position to take full advantage of them. He recommended the exercise of judicious foresight in regard to maintenance and extensions; and he advised directors to take careful written reports—say, every six months—from their managers, as to the capacity and needs of the plant. He said that managers should look carefully into all details, and strive to improve the general condition and efficiency of the works under their charge. Any defect or failing should be repaired as soon as possible; and if any of the apparatus was worn out or too small, a full report on the subject should be placed before the board. Managers were sometimes inclined to suspect the directors of closeness or indifference, when nothing of the kind existed. The directors were chiefly concerned with the financial success of the undertaking, and did not appreciate the need for repairs so plainly as the manager, who was working the apparatus every day, and was therefore in close touch with it. Glancing at modern improvements in the retort-house, the President said he fully appreciated their value, but money was not made in the retort-house alone. Liberal holder room, and large distributing pipes, were indispensable to good working. There was also the question of larger service-pipes, of testing meters periodically, and of dealing with the consumers. A word of commendation was given to the suggestion of the ex-President of the American Gaslight Association, in respect to education and research; and some attention was devoted to gas for fuel and the Welsbach light. Up to the spring of 1895, naphtha was generally used for making water gas; but the price then began to advance rapidly, and a product called "gas-oil," which could be had at about two-thirds the cost of naphtha, was used as a substitute. It was not suitable for all forms of water-gas apparatus; and in some kinds only naphtha could be employed. There seemed to be a growing scarcity of petroleum; and unless new discoveries were made, the price of all petroleum products would be materially increased. As yet but little was known among gas engineers as to the various qualities of gas oils, and the means of valuing the same; and he hoped some of the members would investigate this important subject. The scarcity of naphtha and the excitement in the oil market had tended to increase the demand for gas coal. There were, however, rumours of attempts to force up the prices of gas coal. Naphthalene was still as much trouble as ever; and little more was now known as to the means of preventing it than was the case twenty years ago. Their list of members included several well-educated young men; and he hoped some of them would attack this question. Speaking of municipal control, the President claimed that all fairly conducted investigations went to show that the business of furnishing gas could be better and more economically done by a company than by a corporation. Dealing with acetylene, he remarked that the proposal to distribute this substance in the liquid form had not found favour; and the latest idea was to send it out as a gas from small centres. The subject was of great interest to gas engineers, as opening up the possibility of obtaining a new enricher at a reasonable cost.

Mr. C. W. Hinman was then asked to read his paper, entitled "Notes on Photometry." In the course of some general opening remarks, he pointed out that the accuracy of the determination could not be greater than the accuracy with which the eye can determine the equality of two lights; and that, to ensure the best results, the conditions under which the comparison was made should be such as are most favourable to the eye. Photometry dealt only directly with quantities, and not with intensities of light. Two lights were equal if one had an area of 100 and an intensity per unit of area of 1, and the other an area of 1 and an intensity per unit of area of 100. The importance of a properly made disc for the photometer was pointed out; and the author considered that neither the Bunsen nor the Leeson disc possessed any special advantage. There were at least four methods of working with two lights. There was the moveable disc between the lights, and a moveable disc having both lights on the same side; and either the standard or the candle could be moveable, the disc and the other light being fixed. Examples of these varieties were described. In practice, it was convenient, if one candle only was used, that it should be not less than six inches, nor more than two feet, away from the disc. The author said that in his experience the standard sperm candle used by a skilled operator, with the necessary precautions and corrections, furnished a nearly constant light. The various forms of standard proposed as a substitute for the candle were mentioned; and as regards the gas-burner, the author preferred the argand for gas up to 20-candle power, or containing much nitrogen or carbonic acid, but the flat-flame burner for better quality gases. To get an accurate result with the flat-flame burner, however, it must be tested in at least ten different positions. The average of two tests—one with the flame at right angles, and the other parallel to the bar—gave too low results; and one test with the flame at 45°, gave a nearer approach to the true average. It was a great mistake to burn all kinds of gases at one fixed rate. It would be better to adjust them to give a constant light—say, 20 candles; and the value of the gas could be expressed by the quantity required per hour to maintain a fixed light, after the French method. But to conform to the established method of stating photometrical values, the result could easily be calculated out to 5 cubic feet per hour; and an English Commission had lately recommended this plan. The necessity for a large, well-ventilated photometer-room was not sufficiently appreciated; but a capacity of 3000 to 4000 cubic feet was desirable. The author preferred the Bunsen movable disc photometer to other forms, but with a closed case, so as to avoid the necessity for a dark room. The details of a photometrical test were described at length; and the author went on to say that the photometrical results were not the sole criterion of the usefulness of any given light. The intensity, colour, and steadiness must also be considered, as well as the products of combustion, heat, portability, safety, and cost. The intensity of a light was not of much importance, so long as it did not come in the direct field of vision. An intense light dazzled the eye, but a diffuse one did not; and this explained why opal globes were so largely used, although they greatly diminished the light. A large flame had the advantage of not casting such distinct shadows, and also of possessing greater diffusibility than a small one. The usefulness of any lighting system might be measured by the illumination of the poorest lighted spot in the space under consideration. This was illustrated by a diagram showing the distribution of light in a street lit by 25-candle power burners, 10 feet high and 100 feet apart, and also when it was lighted by 1250-candle power arc lights, 30 feet high and 400 feet apart. In both cases, there was room for improvement; the lights being too far apart in proportion to their height. In theory, the best results would be obtained with a height equal to about one-fourth of the distance between the lights.

Discussion having been invited, Mr. C. J. R. Humphreys said that, while agreeing that the candle might be the best known standard in the hands of a skilled operator, what was really wanted was a quick and fairly accurate way of getting at the illuminating power, which could be used by the men at the gas-works. He would like to ask if there was any standard that could be used in place of the candle. The Methven screen might do for coal gas; but he did not find it satisfactory with mixed gases or with water gas. He also asked which was the best burner for a 28-candle water gas; and how much variation from the 5 cubic feet rate could be allowed in the case of rich gases. Mr. Gifford remarked that one difficulty in quick testing—particularly on the works—was that of getting a fair sample of the gas. If an argand could be adopted to high-quality gas, they would get rid of the difference between the flat flame and the argand, and establish a uniform practice. Mr. Nettleton asked if it was general to place the flat-flame burner at an angle of 45°, and also if the author had had any experience with oil-lamps as a standard. Mr. M'Kay said that a correction for personal error was sometimes necessary. He had observed a regular and constant difference between the returns of three distinct operators. He also found that the gas gave better results during the hot months of the year, with the same enrichers, &c. Mr. Walton Clark much preferred the Leeson star disc to the Bunsen; and for the standard, an oil-lamp with opaque chimney and a slot ⅜ inch wide, extending the whole diameter of the flame, which gave a working light of 5 to 7 candles. It, of course, required to be carefully standardized in the first place. He had adopted this after long experience; and it was especially useful where portability was a consideration. When properly used, the photometer was very reliable.

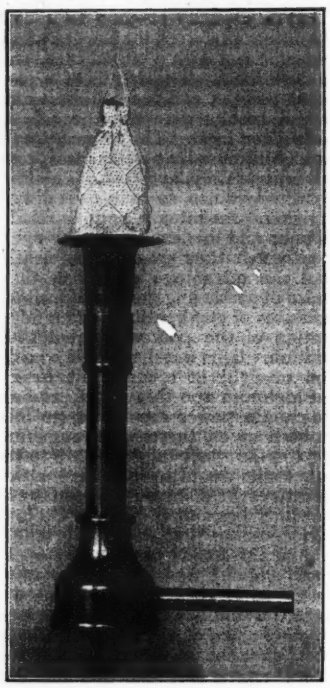
Mr. Hinman, in reply, thought that, next to using a standard candle, the slot or screen was most convenient. He had not had a lengthened experience with screened oil-lamps; but they appeared to be the best known solution of the problem. He considered a flat flame the most useful for 28-candle water gas; and the most efficient burner he had was a Sugg's table-top. As to variation in rate of consumption, he did not object to any that gave the desired candle power. A fair sample of the gas was, of course, indispensable. A badly ventilated room usually told against the gas—perhaps to the extent of a candle or two. The angle of 45° was not an average of the light, but an average of the angles. Jet photometers were good for coal gas, but not for mixed or water gas. He ascribed the personal errors mentioned

to differences between the individual two eyes. If the observers had used only one eye, their results might have agreed. The question of colour-blindness might come in; and there would also be other sources of error. The explanation of Mr. M'Kay's observations as to the gas being better in summer, was simply due to the fact that hot gas retained vapours of benzol and other illuminants better than cold. The hotter gas might also tend to yield a hotter flame; and it was known that flame temperature was important. There was difficulty in balancing lights that differed in colour; and some discretion had to be used.

(To be continued.)

M. DE BROUWER'S INCANDESCENT GAS-LIGHT.

Among the applications for patents which appeared in the "JOURNAL" for Dec. 24 last, our readers may possibly have noticed one by M. de Brouwer, the Manager of the Bruges Gas-Works, for a burner and appliances for supporting incandescent gas mantles. It is claimed for this invention that it constitutes an altogether novel system of lighting by incandescent mantles by simple means and with rather striking results. The specification has, of course, not yet been published; but we are in a position to give some particulars in regard to the new light.



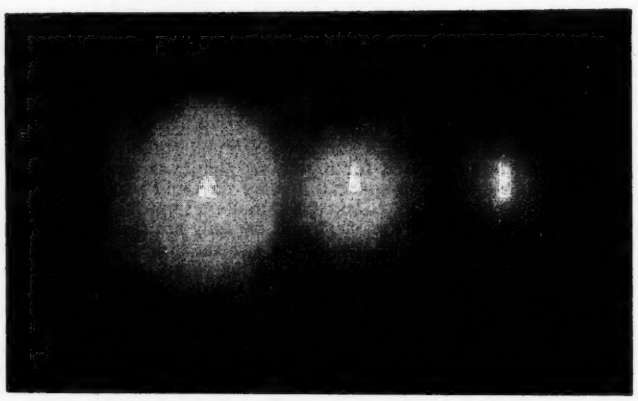
The above photograph shows the lamp in working order. The principle on which it is based is the coupling of an air-blast with the gas-pipe. Air driven in by any of the well-known means—pumps, blowers, exhausters, &c.—is led to the burner through suitable piping, in the same way as gas. The air and the gas reach the bottom of the burner, mix within it, and burn under and upon the mantle. The air has to be about five times greater in quantity than the gas. It may be sent in at about 2 inches pressure through a ¼-inch pipe; and in this way it will be delivered at the rate of 60 feet per hour. But the air and the gas must be exactly adjusted by taps or regulators; small disproportions causing considerable diminution of the light.

The burner consists of a short metal pipe about 1 inch in diameter and 8 inches long. The air is admitted at the bottom, and flows upwards; the gas being sent in at right angles just above the air-inlet. On the pipe is screwed a short cylinder, terminating, as usual with bunsen burners or blowpipes, in a perforated plate, steatite cap, or metallic gauze. On this cylinder a small moveable ring is adjusted at the proper height to suit the size of the mantle, by means of a screw; and to the ring the mantle is attached. This, as shown, is of a somewhat different shape from the mantles used with ordinary incandescent burners; but it is of similar character. The speciality connected with it consists merely in the manner of fixing it and at the same time strengthening it. As will be seen, the mantle is enclosed in a kind of network of platinum wire, the object of which will be explained later on. One advantage possessed by the burner is that it enables chimneys to be dispensed with.

The accompanying photograph will convey a good idea of the proportionate illuminating value of three systems of lighting. The first is the ordinary Argand burner, which, when consuming 9 cubic feet per hour, yields the light of about 27 candles, with (say) 15-candle gas, being at the rate of 3 candles per cubic foot; the second is the Welsbach burner, the illuminating power of which, when new, can be put at 60 candles with a consumption of 3·8 cubic feet per hour, or at the rate of 16 candles per cubic foot; and the third is M. de Brouwer's light, which is of 300-candle power, produced with a consumption of only 12 cubic feet of gas, or at the rate of 25 candles per cubic foot. The light emitted is very much like that of a medium sized electric arc lamp, but whiter in colour. This fact led M. de Brouwer to call his lamp the "Pseudo-Electric Light."

The invention is the outcome of an attempt by M. de Brouwer to remedy what he regarded as a defect in the Welsbach burner—viz., that the greater portion of the light is given by a rather small section (the lower zone) of the mantle; the remainder being rather illuminated than illuminating. In endeavouring to enlarge this highly incandescent zone, he found it difficult to convey to the burner the necessary quantities of air and gas always in the right proportions, and at the same time ensure the resistance of the mantle and chimney. His experiments in this direction produced results of little real value. When, however, he tried the air-blast, doing away altogether with the chimney, he obtained a light equal to from 200 to 400 candles; the ratio being frequently 30 candles to the cubic foot of gas. But it soon became evident that the mantles, if not protected, would be unable to resist the air-blast. To provide against this, M. de Brouwer tried the platinum wire protectors already mentioned; and they proved to be effectual supports of the mantles.

We now come to the practical results of M. de Brouwer's experiments. They may be summarized as follows: The production of a highly-powerful light-giving medium well adapted for public lighting and for the illumination of large halls, factories, railway-stations, and similar places. The weak point in the system is the durability of the mantles; but, of course, this depends to a large extent on the care bestowed upon their manufacture. M. de Brouwer claims for them an average life of 300 hours; but he thinks that this will be improved upon. Another feature of the system which must not be lost sight of is the necessity for double piping. Against this, however, has to be set the greater quantity of light which the inventor maintains can be produced from the gas consumed; and he considers that, when this is taken into account, the additional outlay required on canalization will become by no means excessive.



DE BROUWER. AUER. ARGAND.
DISTANCE 40 C. BETWEEN BURNERS.

The Supply of Kerosene.—A Committee of Baku merchants have petitioned the Government to allow a pipe-line for kerosene to be laid between Michaelovo and Batoum. The "Chemiker Zeitung" correspondent at Baku has announced that heavy storms had completely destroyed the already finished work of restoration of the Transcaucasian Railway, and had inflicted fresh damage; so that the officials on the spot held out no hope of the line being again open for the regular transport of oil before three months have elapsed.

Gas from Sunflower Husks.—Although, thanks to the combined efforts of Messrs. Gilbert and Sullivan, the æsthetic craze of a few years ago, with its accompanying cult of the obtrusive sunflower, has died out, the object of this extraordinary admiration has lost none of its intrinsic worth, but, according to a paragraph in an Australian paper just to hand, has acquired additional value. The sunflower is not all show. Its seeds are employed for feeding poultry; its flowers, for producing a fine yellow dye; its leaves, for fodder; and its stems, for fibre-making. We now learn that the utilization of all these several constituents of the flower does not exhaust its utility; for it has been discovered that the very husks and other refuse are an excellent basis for the production of gas. Experiments have been made with such promising results that at one town in the centre of the sunflower country, gas-making plant has been set up; the intention being to consume the gas in a 40-horse power engine, for purposes connected with the staple industry of the surrounding region. If this should prove successful in working, the sunflower refuse, instead of being a nuisance, as were the residual products of gas manufacture before the chemist turned them into valuable articles of commerce, will, like them, prove to be a source of profit.

REGISTER OF PATENTS.

Manufacture of Oil Gas.—Brentini, P., of Earlsfield, S.W. No. 3354; Feb. 15, 1895.

Into a heated retort or "crucible" of any suitable material and construction, the patentee would cause to fall (drop by drop, or in a fine stream) petroleum or paraffin oil, which, on coming into contact with the heated surface of the retort, is transformed into a vapour, which passes into a condenser of any convenient construction. From the condenser, the gas or vapour is conducted into a chamber, where it is further cooled; and a certain proportion of atmospheric air is added to it by a bellows, pump, or other suitable means. It is then passed into a holder, the rising and falling or expansion and contraction of which is preferably caused to automatically shut off, turn on, or regulate the supply of oil or spirit to the retort, and in some cases to the lamp for heating the latter; and likewise to regulate the motor or other apparatus employed for forcing the air into the gas, and, if necessary, the supply of water to the condenser.

Incandescent Carburetted Gas and Air Lighting.—Hancock, D., Craig, J. B., and Hancock, A. H., of Stratford, Essex. No. 3424; Feb. 16, 1895.

This invention refers to an incandescent arrangement of burner, so constructed that no air is admitted at the burner to mix with the gas; the carburetted air, or admixture of air and gas, being supplied to the burners already mixed, and in proper proportions for burning.

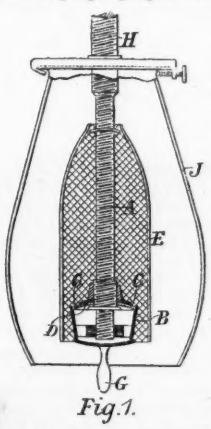
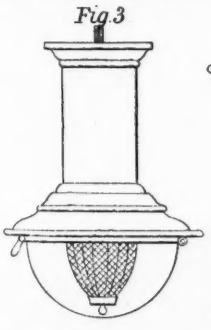


Fig. 1.

In fig. 1, A is a tube for conducting gas down the hollow chamber B to the burner. The "gas" is composed of air saturated with vapour of hydrocarbons or spirit; but in all cases it is delivered to the burners "in the condition necessary for burning," although the patentees do not limit themselves to the composition of the gas. The gas supplied to the chamber B issues from the annular aperture C, around the exterior periphery of the disc of the chamber. The annulus is produced by a diaphragm of wire gauze D, surmounted by a washer of such size as to produce the proper annular opening by which the gas issues and is burnt. Around the down-tube A, and above the burner, is arranged the material to be made incandescent—here shown in the form of a casing E, supported by a nut on the down-tube, which may be adjusted in height vertically. G is a handle at the base of B, by which the whole burner, with its down-tube, may be removed from the gas-supply tube H, and thereby allow of the casing E being replaced. J is a pendent glass or globe carried by a gallery, and open at the base to allow of the burner being withdrawn or inserted.

Fig. 3



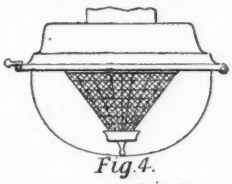
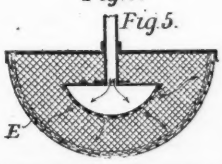


Fig. 4.

Fig. 5.



Burners placed below the incandescent material may be arranged as indicated in fig. 2, the incandescent material having exterior wire cages; also in fig. 3, where the wire cage is of conical form. The object of the wire cage is to confine the incandescent material, and prevent it being damaged. The flames from the burner travel over the exterior surface of the cage and incandescent material, producing "an inverted incandescent lighting apparatus, with an exteriorally arranged non-atmospheric burner." In some cases, instead of the burner being below the incandescent material, the burner may be above, as shown in fig. 4, where the burner is placed within a casing E, so that the flame is directed on to the upper side of the incandescent material; the latter being supported as before by a cage in the form of an inverted cup.

Carburetting Apparatus.—Hancock, D., Craig, J. B., and Hancock, A. H., of Stratford, Essex. No. 3425; Feb. 16, 1895.

This invention relates to apparatus "for rendering air suitable for being burnt as a heat-producing medium for various purposes, but more especially for incandescent lighting, by carburetting the air with the vapour of mineral oils or spirits." The patentees provide for the forcing of atmospheric air (previously warmed or brought to a proper temperature) by means of a fan or pump, working in conjunction with a container for mineral oils or spirits, which are automatically delivered, in quantities properly proportional to the volume of air supplied by the pump, to a saturator or carburettor adapted to cause the air to be carburetted, and from which the carburetted air is delivered to a reservoir, sufficiently carburetted to be advantageously used for heating purposes, particularly for use with non-atmospheric burners for incandescent lighting—for example, for such burners as are described in patent No. 1238 of 1894 and patent No. 3424 of 1895 (described above).

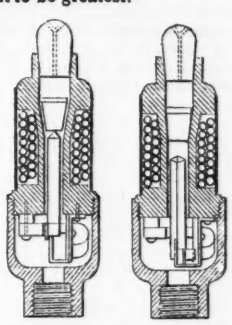
Generation of Water Gas from Coke, Coal, or other Fuel.—Strache, H., of Vienna. No. 3487; Feb. 18, 1895.

The processes hitherto employed for generating water gas, the patentee remarks, are only practicable when coke is used as the fuel. With such processes, generator gas forms during the admission of the hot blast into the coke, and absorbs part of the heat of the fuel, while but a small proportion (35 per cent.) of the generator gas is converted into water gas. In order to utilize the heat thus stored up in the generator gas, regenerators have been employed, in which "refractory stone" is heated by the generator gas burnt by means of a secondary current of air, on which "heated stone" the admitted steam impinges during the gasifying, and is thus superheated before reaching the coke. No very favourable results, however, are said to have been attained by such procedure—chiefly owing to the imperfect construction of the regenerators; and the object of this invention is "to remove all these defects, to render it possible to use not only coke, but also coal or other fuel, and to fully utilize the heat of combustion."

The coking of the fuel is effected by means of superheated steam; and the resulting illuminating gas, as well as the tar vapours, are allowed to pass through a highly-heated column of coke—the hydrocarbon being thereby decomposed into carbon and hydrogen, while sometimes a little carburetted hydrogen or marsh gas is present. The resulting separated carbon deposits itself partly on the coke, while part remains as soot in suspension in the gas; the latter being subsequently removed by washing the gas with water. The superheated steam, which has already served for coking the fuel, passes off simultaneously with the illuminating gas and the tar vapours through the glowing coke, and thus generates water gas, which escapes, together with the hydrogen resulting from the decomposition of the hydrocarbon. The coke then passes directly into the chamber destined for effecting the decomposition of the illuminating gas, tar, and steam.

Electrically Opened and Closed Gas-Burner.—Rudén, E. G., and Norén, K. L., of Stockholm. No. 6952; April 4, 1895.

The devices hitherto used for electrically opening and closing gas-burners have been based, say the patentees, upon the principle that either the valve was made of magnetic material, or a magnetic core or armature was mechanically connected to the valve; so that the valve opened and closed by the attraction of a solenoid and magnet, when an electric current passed through its winding. In order, however, that the valve may close the burner effectually, it is necessary that it should wedge itself into its seat when closed. This necessitates that the power for opening the valve is greatest at the moment when it is to be loosened from its seat; but in the old style of devices, the power for opening the valve is smallest just when it is to be loosened from its seat, or when it ought to be greatest.



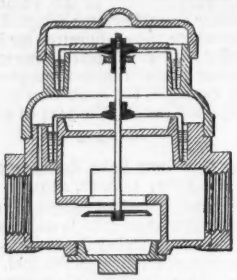
The present invention—shown in its open and closed condition—consists in having the valve made of non-magnetic material, and separated from the magnetic core which, by being drawn into the solenoid, presses the valve open. Also in having the core made of such length, and so placed, that it moves freely a distance before it reaches the valve. This is arranged in order that the core may, during its free movement, acquire such a velocity that, when it hits the valve, the momentum may be transformed into a momentary pressure against the valve several times stronger than that which would result from the attraction of the core alone. For holding the core in the positions corresponding to the open and closed valve, a permanent magnet, having one pole nearer the solenoid than the other, is placed below the solenoid, so that an opening in which the core freely moves is left between the poles. To catch and hold the core so that its lower end can leave either pole without being at the same time lifted by the solenoid and repelled by the pole in question, a hook is provided and this prevents the opening or closing of the valve by shaking.

Gas-Governors.—Smith, J. G., of Montreal, Canada. No. 10,439; May 27, 1895.

This invention relates to gas-governors having inverted cup-shaped floats, with their edges dipping into sealing fluid, and carried by the inlet-valve stem; the object aimed at being to secure a governor the inlet-valve of which will be balanced (or held practically in equilibrium)

by the gas pressure, and "consequently be more responsive in its action to slight changes in the pressure or quantity of gas used."

As shown, the governor is arranged to allow of the introduction of the initial body of gas between two floats, differing in area, for the purpose of controlling the inlet-valve; and it has a main gas chamber



or passage leading to the delivery outlet, and a secondary gas chamber—the latter to contain a body of gas adapted to exert upon the valve-operating parts or floats differing in area a pressure equal to the pressure of the main body of gas beneath the valve.

Production and Utilization of Acetylene.—Ducretet, E., and Lejeune, L., of Paris. No. 16,502; Sept. 3, 1895.

This apparatus is said to differ entirely from those heretofore known, in which "the pressure of the acetylene gas removes the liquid from the carbide of calcium, but does not prevent its contact with water vapour, whereby slow, but continuous, decomposition can take place, with consequent danger and loss of the acetylene gas—apparatus of this kind not being capable of storing it at the high pressure which is produced by its evolution."

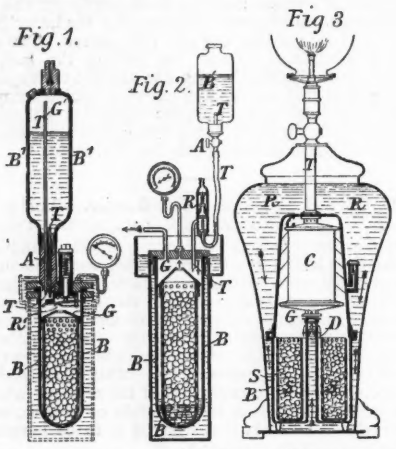


Fig. 1 shows apparatus for producing acetylene at all pressures. A metallic receiver B, containing the carbide of calcium for the production of the acetylene, is closed by a cover secured by bolts. A second receptacle B^1, containing the water, is secured to the cover, and consequently to B. The water passes into the first vessel through the tube T; but, if desired, its passage between B^1 and B may be controlled by the addition of a stop-valve arranged on A. The tube T^1 establishes equality of pressure between B and B^1; and consequently the gas accumulates in the spaces G G^1 as it is generated. In the interior of B is an adjustable regulator R. The water runs into the interior of B and rises to the carbide. According to the adjustment of the regulator R, when the pressure in G is sufficient, the lower opening of the water-supply tube T is closed by the movement of the diaphragm of the valve, and the flow of water is stopped; but it again takes place when the pressure in G is reduced to any predetermined limit.

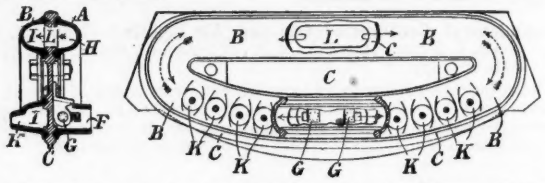
In order to ensure a good distribution of water over the carbide, the latter is placed in perforated cylinders S, with a space left around them, which allows the water to reach the lower part and act on the carbide as required throughout their length. Figs. 1 and 2 show one of these cylinders S. The liquid, in falling, either on the cap or into the funnel C, comes in contact with the carbide of calcium, which is thus uniformly decomposed; and the residual powder passes into B through the perforations.

Fig. 2 shows a low-pressure apparatus, which permits the automatic delivery of the water over the carbide as above described, as well as the proper distribution of the water. The water-supply regulator here is at R. It is a free valve, of any suitable form; and it opens under the pressure of the water, and closes when the pressure of the gas in G becomes greater than a predetermined limit.

Fig. 3 shows a portable lamp. R is the water-supply regulator, bringing the water into contact with the carbide of calcium, as described. The carbide is contained in the perforated cylinders S. The water enters at D, spreads over its outer wall, and acts on the carbide from bottom to top. The refrigerator R serves at the same time as a receiver for the water acting on the carbide of calcium; while its height ensures a suitable pressure of the gas produced, which accumulates in G. Internal zig-zag passages stop the water carried along by the gas. They are placed in the interior of G and of T, and are arranged as already described. Outlets or nozzles, with zig-zag holes, arranged in the interior of T, at its two ends, may also be employed; and a box containing desiccating material may be intercalated in the path of the gas. C is an accumulator, which may be used or not according to circumstances, and which may be placed either inside the lamp or outside. Its purpose is to store up any excess of pressure, and restore it afterwards, if the pressure should fall below the average. Inside a metal casing there is a set of bellows, the top of which is weighted according to the average pressure for which the lamp is set. If any excess of pressure should occur, the gas will enter the bellows and lift the bottom, the weight being lifted at the same time; while the contrary will occur if the pressure falls below the average.

Atmospheric Gas-Burners.—Richmond and Co., Smith, W., and Richmond, E. W. T., of Warrington. No. 18,621; Oct. 5, 1895.

It is claimed for this burner that, by the arrangement of upper and lower tubes, as shown in the engraving, and the courses which the gas and air are thereby caused to take, "the prevention of burning-back of the gas at the nipples (due to down draught and air disturbances) is rendered more certain, a good and efficient admixture of air and gas is effected, and a cheap and easy construction of burner of the type referred to is afforded."

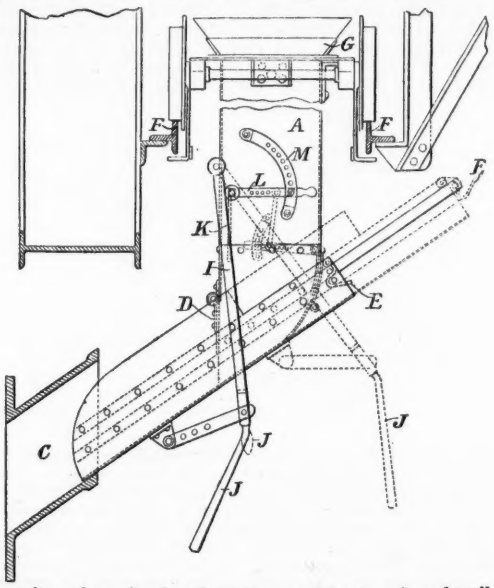


A is the lower trough-shaped tubular part of the burner; B is the upper inverted trough-shaped part; and C is the diaphragm separating the parts. The upper and under sides of the diaphragm at the parts where the tubes come in contact with it, are provided with wedge-shaped channels; and the edges of the tubular parts are of wedge shape, and fit within these channels. The parts A and B form, with the diaphragm C, upper and lower tubes H I. To the lower of the tubes H on the underside of the diaphragm, the gas is introduced by nipples G; and at this part also, through an opening F, the air for admixture with the gas enters. Above this portion, but on the upper tube I, flame-nozzles K are arranged; while on the back-side of the burner, there is an aperture L in the diaphragm, through which entrance from the lower tube H is had to the upper tube I.

In operation, the gas from the nipples G passes right and left along the under tube H; and air enters through F, and passes along with it through the tube H. The gas and air mix together, and flow in opposite streams along the lower tube H towards the opposite ends of the burner; and they then turn and flow towards one another to a central point in the back half of the burner, where the aperture L is situated. At this point, they meet and pass upwards through the aperture into the upper tube I. They then divide, and pass right and left, and round the ends and to the portion of the tube I upon which the flame-nozzles K exist, at which they are burned in the ordinary way.

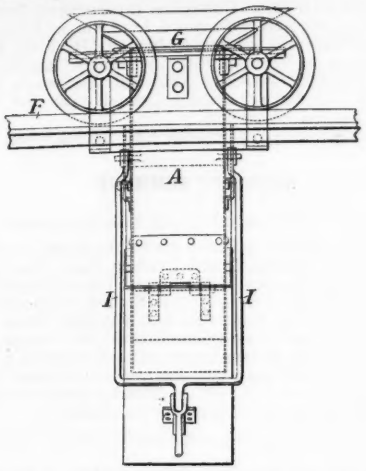
Charging Inclined Retorts.—Herring, W. R., of Huddersfield, and Graham, M., of Lime Street Square, London. No. 24,097; Dec. 16, 1895.

This invention is intended to facilitate the expeditious and even charging of inclined retorts with coal contained in an overhead hopper, by means of a moveable or fixed chamber, regulating a given weight of charge, and actuated by levers. This measuring chamber discharges into a traversing shoot, which forms the subject of the invention.



Upon a line of overhead rails F, the usual hopper-shaped trolley G is made to run. Attached to this by pivots on either side (longitudinally with the direction in which the shoot is to be traversed) is the trunk portion of the shoot, which is of such a length as to be sufficient for the levels of the retorts. This trunk A is preferably circular at the top, and square at the bottom; the lower portion being formed to a mouth discharging in the direction of the mouthpieces C of the retorts. To the sides of this mouth are secured two parallel grooved slide-bars I, working on pivots on either side. The bars support and carry a shoepiece, with guides affixed corresponding with the guide-bars

attached to the shoot-mouth, and in which it slides at the will of the operator. These guides are fixed at an angle which is determined for each special circumstance; the traversing shoe therefore also moving at the same angle, and just so far in a downward direction as to rest on the lip of the mouthpiece of the retort. A stop bolt on the bar prevents this going farther; and the length of the trunk A, combined with the angle of the shoe, insures a constant level, which, however, can be slightly varied by the swaying of the trunk on its pivots, in order to overcome the slight irregularities of the continuous line of retorts.



The actuation of the sliding shoes for the various levels of the retorts from the stage or floor line, forms an integral part of this invention, and is accomplished by a simple arrangement of levers—no telescopic sleeves or shoots, with their consequent complications, being resorted to. The bottom shoot is usually at such a level as to simply require a handle J at the back thereof, by means of which the operator can, after the charge is finished, draw up the shoe smartly; such act bringing into play a self-adjusting catch E, which strikes against a cross-bar fixed to the guides, swinging round by the force of the blow against the bar on its pivot. The catch E falls over, and engages with the cross-bar (as shown by the dotted lines); thus preventing the shoe from again sliding down until the catch is released by the operator. The shoot for the middle and upper lines of retorts—however many there may be—is operated by levers and links, with the main lever of a sufficient length to be within reach of the operator on the stage floor; the arrangement of levers being such as to produce the simple up or downward movement of the sliding shoe by one movement on the main lever or handle—the catch E for automatically holding the same up being used in all cases.

The regulation of the impetus of the falling coal, and its consequent rate of travel into the retorts, is also an integral part of this invention. Hitherto attempts to accomplish this by means of tripping bars, plates, combs, &c.—particularly when attached to the lip of the shoot have, the patentees are able to declare, "signally failed in practice, and aggravated the defect, chiefly by reason of their impeding it just at the point where the flow ought to be at one uniform speed." This invention is said to overcome the deficiency by means of a flap K or valve in the square or lower portion of the trunk of the shoot, with means of actuating from the outside by a lever L and quadrant M. The flap is placed in such a position as to direct the current of falling coal in the reverse direction to which it will flow into the retort through the shoepiece, and against an impact plate or door D. By this means, the coal is directed against the back of the trunk, at such a speed as to give on its rebound therefrom exactly the impetus required to send it in a level layer into the retorts, irrespective of the weight of the charge or the thickness of the layer, which may be varied at will.

APPLICATIONS FOR LETTERS PATENT.

4562.—EMMETT, H., "Incandescent gas and other burners." Feb. 29.
4563.—TURNER, F. W., "Gas and air engines." Feb. 29.
4565.—THORNE, H. A., "Duplex oil and gas engine." Feb. 29.
4572.—BLAIR, J. B., "Fitting lengths of piping." Feb. 29.
4598.—SCHMIDT, A., "Dry distillation of wood, wood waste, and the like." Feb. 29.
4606.—FUNCK, P., and SCHMIDT, L., "Prevention of damage through the bursting of water-pipes." Feb. 29.
4634.—CROW, W. H., "Gas, petroleum, and other internal combustion engines." March 2.
4642.—M'CAIG, W., "Gas-regulating valve and pilot-light connection applicable to bunsen and analogous burners." March 2.
4674.—BROMHEAD, S. S., "Self-regulating gas-generator." A communication from A. Niel. March 2.
4706.—HOMBERGEN, J., "Automatically lighting and extinguishing gas-jets or burners for lighting and heating." March 2.
4766.—ALSTON, C. H. T., "Compound gas-engines." March 3.
4906.—LEES, J., "Incandescent gas-lamps for street lighting and like purposes." March 4.
4923-4.—SIMPSON, W. E., "Gas and other hydrocarbon engines." March 4.
4980.—WHEATLEY, W., and KROS, G., "Carburetted water gas." March 5.
5011.—DUGGAN, P., "Saturators for use in the manufacture of sulphate of ammonia." March 5.
5017.—BAUER, J. C., "Igniting explosive gases or vapours in oil or gas engines, gas-hammers, and the like." March 5.
5029.—HUGHES, T., "Dry gas-meters." March 5.
5051.—SHADBOLT, R. G., and WILSON, J., "Enriching coal gas." March 6.

CORRESPONDENCE.

[*We are not responsible for the opinions expressed by correspondents.*]

The Chartered Gas Company and their Coke Sales.

SIR,—I have read with interest the correspondence in your recent issues respecting the policy of The Gaslight and Coke Company in handling their coke for local and export purposes.

The essential feature of this correspondence is condemnation of the management for selling coke for export at a price lower than that obtained from English cement makers—thus, as your correspondents maintain, enabling foreign cement makers to compete successfully with English makers. This is an old fallacy; and it is quite time that it was exposed. Having been associated throughout with the export of Beckton coke, I am in a position to inform your correspondents that, out of the million tons and upwards which my firm alone has exported, not 5000 tons have been used by foreign cement makers, and no Beckton coke whatever has, during the past ten years, been so used.

With regard to price, it may interest your correspondents to know that the price the Company have obtained from exporters of coke for some years past has been higher than that obtained from English cement makers; and that, moreover, the quantity placed at our disposal for export has, during the past few years, been considerably curtailed, in order that, as we have been informed, the English cement manufacturers might have more liberal supplies from Beckton. This restriction has been carried to such an extent that many of our Continental buyers, who for years relied solely on Beckton for supplies of coke, have been compelled to obtain their fuel elsewhere.

I note that several of your correspondents condemn the policy of export generally, on the ground that it is detrimental to their interests as shareholders. Even assuming that the Directors accept a lower price from exporters than they can obtain from English buyers, such a policy might well recommend itself to them after the experience of past years; for I would remind your correspondents that the Company were originally compelled to find new outlets for their coke by reason of a combination having been entered into by the large buyers of England, with a view of dictating to the Company the price at which coke should be sold. Apparently this combination device has been adopted by the cement makers; and the Company are now reaping the benefit of their policy of keeping in touch with the exporters of coke (a policy the wisdom of which I have always insisted upon), for the quantity which has been placed with my firm alone for export during the coming autumn exceeds that of the aggregate figure for the past three years.

HENRY ROPER.

South Sea House, Threadneedle Street, E.C., March 12, 1896.

Dumfries and its Gas Supply.

SIR,—In your issue of the 10th inst., under "Notes from Scotland," reference is made to a report of mine submitted to the Dumfries Gas Commissioners in connection with trial tests of coal and coal and oil, and the appointment of a Sub-Committee to inquire as to the experience of working with coal, and coal and oil processes in other towns.

The part of the paragraph I wish to take notice of is: "It is not stated what is the occasion for this inquiry; but it is to be inferred that Mr. Malam is meeting with some difficulty in the working of his plant." As no mention is made what kind of plant is here meant, I presume it is the oil-gas plant. I have to say—in justice to the Peebles process, which was introduced here nearly two years ago—that it has worked to my entire satisfaction, and has not given me the least trouble. I have not had any cracked retorts since they were set last year; and the illuminating power of the gas—which, during the winter months, averaged 30 candles—has been maintained at a cost of about 4d. per 1000 cubic feet less than could have been done with cannel alone. The mistake (not mine) that has been made was in supplying gas of too high a quality, which is not suitable for every class of burner.

GEO. MALAM.

Dumfries, March 13, 1896.

The Recent Accident to a Gasholder at Gothenburg.

SIR,—In your issue of March 10, Mr. Niven, of Calcutta, draws attention to the disaster which occurred to a gasholder in Gothenburg about four months ago, and which was fully described in the "JOURNAL" for Jan. 7.

Mr. Niven has a gasholder of similar capacity to the one destroyed; and he appears to be in some doubt as to its stability. He therefore asks for a few more particulars, and concludes by stating his opinion, "that the working of holders in the past has had very little attention; and when a fine new holder like the one in Sweden is destroyed, every question about it is undoubtedly of special importance."

I think Mr. Niven's fears may be easily allayed; for, on reference to the "JOURNAL" of Jan. 7, a section of the Gothenburg holder is shown; and I venture to say there is no other gasholder like it in existence. If there is, the sooner it is rectified the better, or a disaster will undoubtedly occur. The section shows that there were no bottom rollers or cup rollers, the absence of which is fatal to the stability of any gasholder, unless some special device is adopted for keeping the holder level. If Mr. Niven's holder has both bottom rollers and cup rollers—*i.e.*, rollers on the bottom of both inner and outer lifts—he need not have much fear about its stability against tilting, providing the rollers are kept well up to the guides, and that the lifts are not too shallow.

In the Gothenburg holder, the proportion between the depth of one lift and diameter is as 1 to 6. This is very shallow—much too shallow for the safe and easy working of gasholders of ordinary construction. It should not exceed 1 to 5, if it can be avoided. The rollers should certainly not be off the guides by $1\frac{3}{16}$ inches, as in the Gothenburg holder. Such play as $1\frac{3}{16}$ inches is monstrous and unnecessary.

It may be mentioned that all the rollers should be adjusted tight against the guides, when the holder is at rest in the tank. The top

rollers on the inner lift only should be again adjusted tight against the guides when the inner lift *alone* is floating—*i.e.*, just before it takes the weight of the outer lift. There are good reasons for adjusting the rollers in this way; but I need not enter into them.

The questions asked by your correspondent are scarcely to the point. The causes of failure in the Gothenburg holder were: (1) The shallowness of the lifts; (2) the enormous play in the rollers; and (3) having rollers on the top of each lift only, instead of on the top and bottom. This latter defect is alone sufficient to condemn any gasholder. I can, therefore, scarcely agree with Mr. Niven that it was a "fine gasholder," because it was most defective in design.

As regards shallow gasholders, by far the most notable example is Mr. George Livesey's gasholder at East Greenwich, which has a diameter of 300 feet, with each lift only 30 feet deep; or a proportion of 1 to 10. But it must be remembered that, in this instance, special precautions were taken against tilting, in a combination of radial, tangential, and "angular" rollers; so that each vertical post round the circumference of the inner lift is maintained perfectly vertical, during the rising or falling of the inner lift, by the system of roller guiding adopted. In this gasholder, too, the strains were worked out, and everything designed, to suit; but for gasholders of ordinary construction, where no special precautions are taken to meet unusual conditions, it may be put down as an axiom that the proportion between the depth of each lift and its diameter should not exceed 1 to 5.

Of course, the proportion between the diameter and depth of a gasholder, and the arrangement and adjustment of rollers, are not the only things to be considered in designing a gasholder; but they are *the* points called into question by the failure of the gasholder at Gothenburg referred to by your correspondent.

F. S. CRIPPS.

27, *Great George Street, S.W., March* 11, 1896.

Developments of the Use of Coal Gas.

SIR,—A great change has quite recently come over the coal gas industry; and this has been so strongly marked during the last twelve months, that it appears likely in the near future to become a matter requiring serious attention.

It will be well known to many gas engineers that I have, for at least twenty years past, persistently advocated the use of gas as a fuel for commercial and industrial purposes; and although the effect has been, until lately, very small as compared with the possibilities, the practical result in the aggregate is by no means small. The steady slow growth of this department has recently undergone a most startling change; and industries carried on by manufacturers in the good old style run a serious risk of being left behind in the race by those who have adopted coal gas for important work, on a scale previously undreamt of. New developments in the form of special burners and furnaces, on a comparatively large scale, have given a sudden and unexpected rise to a steady demand for appliances for innumerable purposes, entailing a gas consumption which a few years ago would have been looked on as incredible. Burners and furnaces of all kinds, requiring a gas consumption of from 200 to 1000 cubic feet per hour, for continuous work, are now matters of daily demand; and this demand is steadily and rapidly growing. Even now, although the work is new, and to a very large extent special, and therefore costly, the doubt and hesitation of the old times are gone; and manufacturers begin to see that coal gas for exact work is a necessity, at any reasonable price. The daylight and summer service is in many districts growing rapidly, outside the acknowledged one for domestic cooking; and the use of gas on a large scale for manufacturing purposes is growing faster even than my own imagination could have conceived.

The manufacture of apparatus of this class is by no means simple at present, in its comparative infancy; and as a matter of profit to the designer and maker, it is small as compared with the wholesale production of thousands of burners, &c., of uniform pattern. But it is sufficient to require a special staff; and its growth bids fair to make it a very important industry in a short time. The best point is that, once begun, none turn back. On the contrary, fresh developments occur; and the business is now of sufficient importance to make it worth special study and attention. The long expected has come to pass. Rows of furnaces heated by coal gas may now be seen where until recently foundry coke was used; and, what is much more to the point, these furnaces—after experience and after paying the gas bills—are being added to, and larger ones are being built.

Bearing on this subject, a paragraph now going the rounds of the Press, referring to some remarks by Herr E. Schweitzer on "The Use of Gas for Singeing Fabrics," is worthy of note. The facts as stated by him may now be true on the Continent, and might have been so in England fifteen or twenty years ago; but his information is sadly behind the times so far as this country is concerned. The slit-burner described is a relic of the past. I have not seen one in use for at least ten or twelve years; and those of your readers who are engineers will appreciate the impossibility of retaining the absolute truth of a tube with a slit $\frac{1}{16}$ inch wide, and of any length from 3 feet to 15 feet—the burner being subjected while in use to excessive changes in temperature. As a matter of fact, these slit-burners never remain true; and the work done by them is defective. There is no difficulty in producing burners giving an absolutely uniform flame, without break, and of any length. The curious difficulty made by Herr Schweitzer, as to starting the web and flame simultaneously, has no existence in modern machines. The web travels over a roller carried by two quadrant-arms, which are vertical while the burner is being adjusted. The turning down of the arms starts the machine, and places the cloth in the exact position required. No doubt, there are antiquated machines in which trouble occurs.

The absolute precision and practically unlimited power which can be obtained by the use of coal gas as a fuel, and the ease with which automatic control arrangements can be made, place it in the first rank as a fuel where precision of results and economy of skilled labour are important; and those employed in industries where these conditions are important are becoming rapidly aware of the facts.

Warrington, March 11, 1896. THOS. FLETCHER, F.C.S.

PARLIAMENTARY INTELLIGENCE.

HOUSE OF LORDS.

The following progress was made with Bills last week:—

Bill read the first time, and referred to the Examiners: Cupar Water Provisional Order Bill.

Bill read a second time: East Surrey Water Bill.

Bills referred to a Select Committee consisting of Lord Poltimore (Chairman), the Earl of Stamford, Lord Kinnaird, Lord Ampthill, and Lord Stanmore, to meet on Monday, March 16: British Gaslight Company (Norwich) Bill, Cheltenham Gas Bill, Newcastle-upon-Tyne and Gateshead Gas Bill, Redheugh Bridge Bill, Ystradyfodwg Urban District Council Gas and Water Bill, Ystrad Gas and Water Bill.

A petition was presented against the East Surrey Water Bill.

HOUSE OF COMMONS.

The following progress was made with Bills last week:—

Last Friday, the following Bills were on the paper for second reading: Chelsea, East London, Grand Junction, Kent, New River, West Middlesex Water (Transfer) Bills, Kent Water Board Bill, East London Water (Height of Supply) Bill, Staines Reservoirs Bill, New River Company Bill, and Southwark and Vauxhall Water Bill. The President of the Local Government Board (Mr. Chaplin), however, suggested that it would be convenient to have them all postponed to the same day—viz., the 24th inst.—as the Government intended to introduce in the House of Lords on Monday their own Bill dealing with the general question. This course was agreed to.

Bill read a second time and committed: Colwyn Bay and District Gas Bill.

Bills referred to a Select Committee consisting of Sir W. Coddington (Chairman), Sir L. Lyell, Viscount Weymouth, and Mr. Johnson-Ferguson, to meet on Tuesday, March 17: Brighton Corporation Water Bill, Fylde Water Bill, Guildford Gas Bill, Huddersfield Water Bill, Matlock Bath Gas Bill, South Metropolitan Gas Bill, Whittington Gas Bill.

Bills referred to a Select Committee consisting of Sir J. Kitson (Chairman), Sir W. Dunn, Mr. C. J. Murray, and Mr. E. Moon, to meet on Wednesday, March 18: Barnsley Corporation Water Bill, Rotherham Corporation Bill, Sheffield Corporation Water Bill.

Bill reported, read the third time, and passed: Cupar Water Provisional Order Bill.

A petition was presented against the Lanarkshire (Middle Ward District) Water Bill.

HOUSE OF LORDS COMMITTEE.

Withdrawal of the Opposition to the Birmingham Corporation Water Bill.

The above-named Bill came last Thursday before a Select Committee presided over by the Earl of Camperdown. Its objects were set forth by Mr. Pope, Q.C., who said it was a measure to relieve the Corporation of Birmingham from the operation of a clause in the Bill of 1892, which defined an agreement with Sir Richard Green-Price as to the deposition of spoil excavated from the Corporation reservoir and aqueduct works at Frankley. The obligation upon them was to so dispose of the spoil as to raise to its original level the surface of lands entered upon. It had been found, however, that the quantity of spoil displaced was more than sufficient for the restoration of the surface level; and the question the Corporation had to consider was what should be done with the excess. The provision of the applying section was that all materials not used by the Corporation should be disposed of as might be agreed between the owner of the land and the Corporation; consequently, if the owner did not agree, he was able to put a stop to the whole works. When the agreement was made, there was no idea that the amount of spoil would be so large. The result was, although he did not desire to say anything detrimental to the petitioners against the Bill, that there was a tendency to "put the screw on" the Corporation, seeing that they had been driven into a corner, from which they could not escape without the assistance of Parliament. The promoters did not wish to alter the bargain they had made with Sir Richard. What they suggested was that they should be at liberty to take the excess spoil from his land without reference to the agreement, and compensate him for any damage done. Mr. J. Mansergh, M.Inst.C.E., the Engineer of the works, was called in support of the opening statement. In cross-examination by Mr. Balfour Browne, Q.C., representing Sir R. Green-Price, witness said this petitioner objected to the measure of 1892; but he withdrew his opposition when the agreement referred to was arrived at. Mr. Browne asked what it was the Corporation wanted; were they asking for sites whereupon they might deposit the excess spoil? Witness rejoined that what was desired rather was the right to remove spoil from Sir Richard's land without his consent. Mr. Browne asked if it was not a fact that his client held in his hands the key of the Birmingham water supply. Witness said it amounted to that if Sir Richard insisted upon the terms of the original agreement. Subsequently, the petition of the Rev. W. E. Prickard, another objector, was dealt with, in regard to which the Town Clerk (Mr. E. O. Smith) went into the witness-box, and stated that the present Bill did not injuriously affect the petitioner's protective clause in the Act of 1892. Mr. Balfour Browne, addressing the Committee, urged that the Corporation should be compelled to adhere to the terms of the original agreement. Sir R. Green-Price could compel them to leave the spoil on his land, or to purchase land whereupon it might be deposited. But they preferred to keep the spoil. His client wanted the spoil which the Corporation had no use for deposited in the manner set out by the agreement. Counsel for Mr. Prickard having asked their Lordships to continue the protection afforded him by a specially-drawn

clause in the Act of 1892, Mr. Pope briefly replied for the promoters. In the result, the Chairman intimated that the Committee were of opinion that the case was one in which there ought to be an agreement. If none could be arrived at, the Committee would pronounce upon the matter; in which eventuality they must, of course, have regard to the great public importance of the water undertaking of the Birmingham Corporation. Just before the rising of the Committee for the day, the opposition to the Bill was withdrawn; it being stated that the promoters undertook that the powers sought should not be used to the disadvantage of Sir Richard Green-Price, and the sum of £500 to be paid by the Corporation.

LEGAL INTELLIGENCE.

HIGH COURT OF JUSTICE—QUEEN'S BENCH DIVISION.

Monday, March 9.

(*Before Mr. Justice* WILLS.)

The Incandescent Gas-Light Company v. The De Mare Incandescent Gas-Light System, Limited, and Others.

This action came on for trial this morning. The plaintiffs asked for an injunction restraining the defendants from continuing to infringe certain letters patent granted in 1885 to Baron Auer von Welsbach, for an invention entitled "The Manufacture of an Illuminant Appliance for Gas and other Burners." Plaintiffs also claimed damages in respect of the alleged infringement.

Mr. MOULTON, Q.C., Mr. TERRELL, Q.C., Mr. WALTER, and Mr GREY appeared for the plaintiffs; Mr. BOUSFIELD, Q.C., Mr. ROGER WALLACE, Q.C., and Mr. JENKINS, for the defendants.

Mr. MOULTON, in opening the case, said that this was an action for infringement of the patent granted to Baron Auer von Welsbach, No. 15,286 of 1885. He claimed that the invention was one of those great inventions which for ever changed the work of the world in the department to which it referred, and, in fact, revolutionized the industry to which it was applied—in this case, the economic production of light from coal gas. The only way to get a fair idea of the importance of the invention was to contrast the state of knowledge prior to, and after, its publication. He should therefore trace the main steps of advance in these matters. Among the anticipations cited were several previous patents, which he should be able to deal with to some extent in his opening. It had long been known that radiation was a form of energy; that it varied very greatly; and that it might appear in the shape of heat, light, or invisible rays, which had powerful chemical effects. The amount of heat was absolutely fixed, and the amount to be obtained from any given substance could not be increased; but it might be obtained in various forms, either as heat or light. The problem of obtaining light by incandescence was that of changing the pitch, so to speak, of the vibrations, so as to make all the heat rays appear in the form of light. Gases, even at the highest temperatures known, had hardly any illuminating power in them; even the oxy-hydrogen lamp giving barely any light. But, if a gas were highly charged with particles of carbon, these became heated to a high temperature, and gave rise to the white flame seen in a good gas-burner. It was the solid bodies, therefore, which emitted light when raised to a high temperature. The first attempt at utilizing this fact was made by Sir Thomas Drummond, in what was known as the limelight—a jet of oxygen and hydrogen being made to impinge on a block of lime. That was about 1826; and nothing further was done until the first patent cited as an anticipation—that of Mr. Cruickshank, who attempted to produce light by raising platinum wire to the point of incandescence. The difficulty was, however, that all metals were good conductors of heat; and it was impossible to keep up the temperature except on a very small mass of the metal. But if the platinum were made very thin to attain this object, it readily melted, and not only that, but it formed a carbide, and disintegrated. Innumerable patents for platinum caps had been taken out; but none had proved successful on a practical scale. M. Clamond had spent years over this problem; and he conceived the idea of making magnesia, lime, or zirconia into the form of thin threads in a kind of basket form, and exposing them to an intense heat. This was another great step in advance, as it overcame the difficulties involved in the use of metals. On the other hand, they had difficulties of their own, being extremely fragile, and short-lived; and, in fact, they never came into practical use, and were only remembered as interesting steps in the progress of science. This brought him (Mr. Moulton) down to 1883; and he exhibited a diagram of Lewis's patent burner brought out in 1882, showing the latest attempt at an incandescent platinum lamp. He also handed in a drawing of one of Clamond's earlier lamps, in which the gas, mixed with heated air, burned downwards and impinged on a small magnesia basket, supported by one of platinum. This was not cited as an anticipation; but another one, somewhat earlier in date, was. In this the flame impinged on several little needles of magnesia. The last patent of Clamond, in 1883, was an upward burning lamp, of the same general design; the air supply being heated, and the flame playing on a basket of magnesia. This lamp, which required a long chimney to secure sufficient draught, he believed, never came into practical use. A deal of gas was wasted heating the air; and the lamp was complicated. The basket was constructed by making a paste, which was formed into shape, and dried. He had not been able to obtain this burner; but he had one of a similar character made by a subsequent inventor—Lungren. Another invention which was very useful, but was not intended for domestic purposes, was Fahnehjelm's. In some industries, there was a large use of water gas, which was cheap, and gave a hot flame, and a magnesia lamp for such factories was invented by Fahnehjelm, and was used to a considerable extent. This was the state of public knowledge when Dr. Auer von Welsbach's invention was made. He was a chemist who discovered that, by taking a fabric of organic fibre, preferably cotton, and steeping it in a solution of a salt of some refractory earths, and then burning it, a skeleton of refractory oxides could be obtained which would become incandescent, and was free from the objections previously existing. But besides this, he made another discovery, which lay at the root of all successful attempts at incandescent lighting of this kind. He found that there were certain rare earths, generally if not always associated together, which had properties specially suiting them for employment in this manner. They were so similar—behaving in the same way with many reagents—that their separation from each other was one of the greatest difficulties in inorganic chemical analysis. He (Mr. Moulton) doubted if any two chemists agreed as to how many there were, and how they could be isolated, or whether they could be isolated at all. These rare earths were oxides of equally rare metals. They might, for convenience, be divided into the cerite and yttrite groups; and they could only be distinguished by fractional precipitation. Dr. Welsbach for the first time discovered that these oxides were not only very refractory to heat, but that they had the property of giving out light when incandescent in a very high degree. His invention, therefore, consisted in using these oxides, either alone or in connection with other refractory materials, for the purpose of making the solutions with which to saturate the cotton fabric, which, on being burned off, left the skeleton behind it. The secret of success lay in the use of a solution to form the fabric, and in employing the proper salts to prepare the solution. The form in which the skeleton remained, consisting of immensely fine fibrils, gave it the elasticity which enabled it to withstand expansion and contraction, consequent on violent changes of temperature, without falling to pieces. When this invention was published, the sources of these rare earths were investigated, and larger supplies were discovered; but the characteristics of all successful attempts were those which he had named. That was the invention; and of its great utility there could be no question. It was the only rival of the electric light; and, in some cases, the successful rival. It produced a wonderful economy of gas—far beyond anything attained by regenerative burners, especially for domestic purposes. It not only diminished the consumption of gas, but consequently the heat and contamination of the air in a room. Two documents alleged as anticipations he had not referred to, because he should submit that they ought to be rejected, as not representing public knowledge, or in any way conflicting with the rights of the plaintiffs. The first was a provisional specification, filed by Mr. Williams in 1882, for what he called a thermo-candle. Assuming it meant a kind of burner, he gave some 48 directions as to how it should be made; and, if they took all his suggestions, two or three hundred thousand were made. They would cover everything from gilt macaroni to a black-leaded mince-pie. All the suggestions were of the most general character; and no one but the author of the "Hunting of the Snark" could compete with him. Fortunately, they had discovered the source of his inspiration. The provisional specification was never completed. But, on the same day, he put in another, which he did follow by a complete specification; and, though he could not say anything much more complimentary about it than about the former, still there was an intelligible thread running through it. It was to be applied to electric incandescent lighting; and, again, there were some thousands of directions for making refractory films. It was very crude and imperfect. But it had a plain reference to electricity; and he seemed to have included everything he suggested for use in an electric lamp into his provisional specification for a thermo-candle, whatever that might mean. It contained no real knowledge, and conveyed none; and he submitted it could have no effect in limiting the rights of an actual inventor. The second document was of a different kind; but he should ask his Lordship to reject that also, on the ground that it reeked with bad faith. The man Frankenstein, who was spoken of in it, appeared to have approached near one of the features of Dr. Welsbach's invention, though there was still a wide gulf to be passed; but he never told the public how to carry out his invention. He seemed to think he would do better by selling a book telling people how to make the burners, than by selling the burners themselves. Confessedly, they could only be lit once; and it would be shown that they would not, even when made according to the directions, stand lighting at all. He believed Frankenstein must have gone farther himself; but he did not disclose it if he had. He made a mixture, but not a solution; and therefore the mantles failed. Plaintiffs' witnesses would show that, following the instructions given, no success could be obtained; and he should therefore ask his Lordship to reject the specification. [The learned Counsel then proceeded to deal with the Welsbach specification, which is familiar to readers of the "JOURNAL." He explained it in detail to his Lordship; drawing special attention to the passage where it was stated that, instead of using oxide of yttrium and oxide of lanthanum, yttrite earth and cerite earth containing no didymium respectively might be employed. Also to the statement that the fabric must be saturated in an aqueous solution of the nitrate or acetate of the oxides mentioned. The process of burning off an impregnated mantle, so as to leave the skeleton of refractory material behind, was then performed by Mr. Swinburne; and the result was handed up to the Judge. Photographs were also put in of the mantles, highly magnified, before and after burning off—one of the latter having been used for 300 hours—and of single fibres in their various stages.] The learned Counsel then read the claim—viz., "the construction of an illuminating appliance for gas or other burners, consisting of a cap or hood of a fabric impregnated with the substances mentioned, treated as set forth." The defendants, he proceeded, were a Company who had threatened to sell and make an appliance, which plaintiffs submitted was an infringement. Instead of making a hood, they used individual threads forming a fringe, which, he submitted, was only a colourable imitation. Dr. Welsbach said the form of the fabric might be varied according to the burner employed. The defendants, he understood, proposed to use a flat-flame burner. There would be a certain dispute as to what materials defendants used. Some said the substance was largely zirconium, combined with yttrium; others said it was erbium. But it did not matter which it was. The fact that the exact constituent employed could not be isolated only showed that it was one of the family mentioned, which were so closely allied; and there could be no doubt that the pith and marrow of the plaintiffs invention had been taken.

Professor *James Swinburne* was the first witness. Examined by Mr. TERRELL, he said he had made a special study of this subject, and had carried out a large number of experiments on lighting with gas by various modes. The source of illumination in ordinary gas lighting was generally supposed to be the fine particles of carbon raised to incandescence. The efficiency of any lighting apparatus depended on the amount of energy converted into light. The average efficiency of coal gas was from 2¼ to 3 candles per cubic foot. The Drummond light was the first attempt to produce light by the incandescence of a body other than the combustible itself. Having described the action of the limelight, he continued: Zirconia was discussed in connection with the oxy-hydrogen light, and also magnesia, prior to Welsbach's atent; and sometimes the two together. Bunsen burners had been in use for a long time for getting a high temperature; and attempts were made to produce incandescence by using platinum hoods over such burners. Cruickshank's patent was of this character. He proposed to coat a platinum basket with lime, so as to improve the incandescence, and, at the same time, strengthen the platinum. He (witness) had not succeeded in making a mantle on this principle as the lime cracked when heated, and tumbled off. There was nothing in the specification which anticipated Welsbach. Dealing with Clamond's patents of 1880, witness said the incandescent material consisted of sticks or rods of magnesia or other metallic oxide. They were not produced by the decomposition of a salt within a fabric. A small rod would require more heat to raise it to a given temperature than a fine thread. Clamond employed a special hot-blast burner for this purpose; and this really formed the substance of his invention. In his 1883 patent, he used a magnesia cage. It was made into a paste, and squeezed through a hole as in the manufacture of vermicelli. The threads (which were about the size of vermicelli), while still damp, were wound into a sort of basket, and allowed to dry. He used a hot-air bunsen burner, simpler than the other one; but the air was heated by small gas-flames in the interior of the burner. There was no pressure on the air; but there was a rapid flow. Neither of these inventions had lived. Fahnehjelm in his patent of 1883 used lamellæ or small wires of refractory oxides, heated by being put over the burner, which was supplied with water gas. He used oxides of magnesium, calcium, zirconium, or silicon, which were mixed with some gelatinous substance, and formed into a paste. This was squeezed through holes to form the wires, which were afterwards dried. This form of burner had been practically used, but was not applicable to domestic lighting. Besides those mentioned, he knew of no other anticipation of Welsbach's patent. He had read Frankenstein's specification, and had unsuccessfully tried to make a mantle according to the method described. As soon as the carbon was burned, the oxides fell away into an amorphous powder. He failed to get cohesence in the oxide, though he tried his best. Having regard to his experiments, and to the results said to have been obtained by Frankenstein, in his opinion something else must have been done which was not described. Coming to Welsbach's invention, and dealing first with the process that consisted in taking an organic structure or fabric, and getting an image of it in oxides which were refractory (which he did by soaking the mantle in a solution which would leave the oxides when burnt), the result was that every separate fibre absorbed some of the solution; so that, when burned off, each fibre practically was left behind in the form of oxides. While the organic matter was being destroyed, the oxide was formed in the same shape. The result was to get adherence between the particles of oxide which were the result of the decomposition. They appeared to be built up as the salt was decomposed by heat. This result could not be produced unless a solution were used.

By his LORDSHIP: Witness could not say the exact physical process was quite understood; but he had no doubt the oxide was gradually built up as the decomposition proceeded.

Examination continued: That was the essence of the success of the invention. At the date of the invention, the rare earths mentioned had hardly been used at all, with the exception of zirconia. The constitution of yttrite earth was a blend of oxides, whose chief characteristics were their long names. They were found in yttrite minerals, and the oxides stood very high temperatures, without volatilization; and, when heated, they gave a full white light. These minerals varied in their constitution, both in the number and proportion of their constituents. Cerite earth was another blend of similar oxides in different proportions; the oxides formed in it also yielded a pure white light when heated, except one or two, which were coloured. Didymium was sometimes found in cerite earth; and if it were present in any considerable proportion, it injured the light. It was a coloured body in itself. The constitution of these bodies was not yet accurately known, nor could they be exactly distinguished. Both physically and chemically they were much alike, except those which were coloured. All the colourless ones were suitable for this purpose. Lanthanum was apt to absorb carbon. He had not personally analyzed these substances; but, from reading, he knew what were the results. These earths could only be separated by fractional precipitation, which had been carried out to the extent of 300 times. For manufacturing these mantles, such work was useless; it was only necessary to get rid of any objectionable oxides. He had made a number of experiments on these mantles. He tried the ordinary mantle, as used, and also fabrics in use at the time—book muslin, Brussels net, and an ordinary knitted stocking. He tried different strengths of solution, and also with and without the use of ammonia gas. The first experiment was with book muslin; the solution containing 60 per cent. of zirconia, and 20 per cent. each of lanthanum and yttria. He used ammonia, and was quite successful in making a mantle according to the directions. The fabric was washed in hydrochloric acid, dried, and dipped in a solution of a strength of 10 or 12 per cent. of nitrates of the earths. The superfluous moisture was squeezed out; and while still wet, he held them in the upper portion of a beaker, in the lower part of which was strong ammonia, leaving them there until they smelt strongly of ammonia. The ammonia united with the nitrogen of the nitrates, and the oxides were thrown down as a gelatinous deposit. The mantles were then dried, and roughly shaped by the fingers. He then held one over a bunsen burner; and the result was a mantle, not as nicely finished as those commercially used, but still it was a fairly good one, and gave light. In order to avoid using modern language, he gave the specification to two assistants, and told them to make mantles according to the directions. The same experiments were repeated with the other fabrics, and similar results were obtained. In other experiments, he substituted magnesia for zirconia, and also produced good mantles. Magnesia was cheaper than zirconia. In 1885, zirconia was very expensive; and the other substances were almost impossible to obtain. Since then, however, they had been discovered in other places. The strength of the solution was not mentioned in the specification; but it could be easily ascertained by experiment. If too strong, the oxide formed scales on the fabric; if too weak, the fabric would shrink. A fabric required a particular strength to obtain the best results. The extremes he went to were: 16·2 and 3 per cent. of the oxides by weight. In both cases, the mantles were efficient; but, in the latter, they were weak. He did not see how the proportion could have been stated exactly, because it depended on the fabric. Thorinum was one of the rare earths to be found in yttrite earths. He had made experiments with single oxides.

Mr. BOUSFIELD objected to this evidence. The patentee, he said, described the use of a combination, not of single substances.

Justice WILLS thought he had better take the evidence.

Examination continued: Witness had tried some experiments on the behaviour of these oxides separately, or as separate as he could get them. The general result was that they all made mantles; but some did not give a good light. He tried didymium, cerium, thorinum, zirconium, erbium, yttrium, lanthanum, and also the nitrates of the metals of citrite earth and yttrite earth, and combination of the two. He tried both nitrates and acetates, with similar results; but there was more difficulty in dissolving some of the acetates. These substances might be called equivalents for the purpose of incandescent lighting. The effect of the ammonia was that one did not burn one's fingers in handling the mantles, which were strongly acid; the ammonia neutralized the acid. An excess of nitric acid had to be used to keep the zirconium, for instance, in solution. He had seen the alleged infringement in this case. It appeared to consist of a large number of threads of flax, tied round a platinum wire, to be passed through them all. They were dipped, he believed, in a solution of the earths and sent out unburned. The arrangement was then put on the top of a burner which first burnt off the organic matter, and then the remaining matter became incandescent. It was intended to be applied to a flat-flame burner without a chimney. When such an instrument was in use, the oxide came in contact with the hottest part of the flame. It was practically identical in operation with the Welsbach patent. Except for the shape of the fabric, if it were impregnated with a nitrate of zirconium or yttrium, it was the same in constitution. He should say the same if erbium oxide were introduced. There was the slightest possible difference, chemically, between yttrium oxide and erbium oxide. He had tried to obtain yttrium and erbium salts from manufacturers abroad, but had not succeeded. He did not think it possible to obtain either of these salts pure. Erbium was present in both, as shown by the spectroscope, though one was labelled erbium and the other yttrium. For the purpose of mantle making, he did not think this was material. A single thread could be treated, if necessary.

Cross-examined by Mr. BOUSFIELD: A thread was not a fabric in a commercial sense; but, in another sense, it was. Welsbach described a fabric only. In a case like this, he should call a bundle of threads a fabric. In a subsequent patent, Welsbach referred to a number of threads suspended from a platinum ring. A good many bodies were known as incandescents. Lime was the oldest; and then came magnesia and zirconia. Other earthy oxides were referred to in chemical books, as incandescing in a hot flame. Berzelius, in 1830, referred to zirconia in powder in a blowpipe flame. Liebig, in 1865, referred to erbia in a similar way. Other extracts of the like nature were read, in which yttria was mentioned as an incandescent body giving a white light. Witness said he knew the books by name, but could not say he had read the extracts. Alumina was also known to possess the same property. The bodies mentioned covered all the substances specially named in the specification, except lanthanum, but not all included in the term "yttrite earths." Various attempts had been made to apply some of these bodies to lighting. Cruickshank was correct in his principle and theory, though his earthy matters tumbled off the platinum. He described a mantle similar to plaintiffs', only made of platinum. He referred to lime "and other earths;" he might have referred to magnesia or zirconia. Witness could not say whether, at that date, he alluded to yttria. The principle was there, if it could be worked. Reference was next made to a specification of Mr. Edison's for an electric incandescent lamp, in which he referred to a platinum wire being coated with nitrate or acetate of zirconium, yttrium, or cerium. It was known that these were bodies which were refractory and incandescent at high temperatures. They would not reach such a temperature in the case referred to, because the platinum would melt before it attained a sufficiently high temperature to make them incandescent. He thought the temperature of a mantle in a bunsen burner was higher than melting platinum. The whole theory was that, in a very finely-divided state, these bodies took the actual temperature of the flame itself; and the colour of the light was another indication of the temperature. The light of a Welsbach mantle was much whiter than that of melting platinum. M. Chatellier had invented an instrument for telling high temperatures by the colour of the light. Coming next to Clamond's specification of 1880, he referred to metallic oxides; and the advantage of subdivision so as to get an extended surface was recognized. That was further shown in his subsequent patent of 1883, in which, a cage of threads of magnesia was used. It might be termed a fabric of magnesia; but he thought it was not interwoven. A cage made since the patent by Lungren was put in, and was said to be of magnesia. It was substantially the kind of thing Clamond described. Coming to Fahnehjelm's patent, the pins might be made as small as in the Lungren type. In general appearance, defendants' fringe resembled this more than it did the Welsbach mantle. It made no difference whether or not water gas was used.

Tuesday, March 10.

Professor *Swinburne* was this morning further cross-examined by Mr. BOUSFIELD in regard to Williams's provisional specification. Several

passages having been read, witness said Williams was contemplating the use of a group of materials, which would give a finely-divided coating of a refractory substance. Some of the descriptions would apply to the Welsbach mantle in general terms. As regards form, it was nearer the Welsbach than the Clamond, so far as one could gather anything intelligible from it. The description did not show that the author had an intelligent idea of what he wanted, though it was consistent with it. An inventor generally made his provisional specification as broad as possible; but he had also observed that the broadening of the provisional specification tended to prevent the success of the complete one. Williams suggested dipping a piece of textile material into a solution of a salt, such as magnesia, or any suitable salt or oxide. If he did this, and afterwards burned it, it would be very similar to the Welsbach. He also suggested that the coating thus obtained, could then be coated with other metal by immersion in a solution of that metal; but he did not think it could be done as he suggested. He did not think the word "metal" was used in the sense of metallic salt.

Justice WILLS pointed out that, in some passages, Williams drew a distinction between metals and such substances as zirconia, or other earths.

Witness was next cross-examined upon Frankenstein's lamps as described in the "Technologist," Vol. X. They were termed solar and lunar; the former burning oil or gas, and the latter alcohol; and each had a cone of gauze coated with cream of lime, mixed with gum to make it adhesive. He described the burning of the tissue, and destruction of the carbon, in a way which corresponded, to some extent, with the Welsbach. The tissue was to be burned out, and the earthy matters remained; but, these earthy matters, as he understood, did not impregnate the fibres, but remained on the outside. The cone was termed a "multiplier;" and a fresh one had to be used each time the lamp was lit.

Mr. MOULTON here objected that a description about to be read by Mr. Bousfield was not included in the particulars.

Mr. BOUSFIELD said the particulars referred to the volume from which he was quoting, but only gave the page at which the article commenced; the one he was about to read being at a subsequent page. A copy of the translation had been sent to the plaintiffs. If this were excluded now, it could be got in afterwards in other proceedings.

Justice WILLS said that if plaintiffs had had notice of it, it ought to be admitted; otherwise it was not fair to introduce it now.

Some discussion ensued as to what had actually taken place between the Solicitors; and the article in question was handed to Mr. Moulton. He said it was simply a French edition of a German document, which was in the particulars; and he therefore withdrew the objection.

Cross-examination continued (Mr. Bousfield having read from the "Technologist," further details of the manufacture of the "multiplier"): It appeared that the object was to get the paste worked, as far as possible, in among the fibres; but he did not think such a paste would penetrate into the interior of the fibres, as a solution would. The magnesia and chalk were in a solid form, not in solution. The fabric was shaped on a wooden cone the size of the burner, but rather longer; that was probably to allow for contraction. A similar account was given in a German periodical, "Dingler's Polytechnische Journal." In Welsbach's 1886 patent, there was a direction for making mantles, in which it said that all the salts need not be in solution, but might be in the liquid in a pulverulent form. Looking at this passage, he still thought the distinction he had drawn in the case of Frankenstein between paste or cream and solution, was of the greatest importance. Lime was slightly soluble in water, and that solubility was increased by the addition of gum arabic. It differed, however, substantially from the effect which would be produced by the method described in Welsbach's 1886 patent. The Frankenstein mantle was very fragile; he had not been able to get one to hold together at all, following the description as closely as he could. The Welsbach mantles sometimes failed; but never to the same extent as the Frankenstein. He attributed the failure to the difference between a paste and a solution. Using a solution of acetate of lime, instead of a paste, he got a mantle. He did not think, however, he could obtain a mantle by using Frankenstein's method and Welsbach's material; but he had not tried. The problem set by Frankenstein was left as it was before. He could not say that all that remained was to get a material which would hold together. If one took Frankenstein's organic material, and treated it according to Welsbach, one would get a mantle. One could take Welsbach's nitrate and proceed to a certain extent according to Frankenstein; but the other part of the directions was inconsistent. If one made a cream with zirconia, and followed Frankenstein's directions, witness did not think a mantle could be made. Frankenstein certainly contemplated having a skeleton of earthy oxides, by burning out the organic fabric on which it was formed. Witness had not analyzed the defendants' fringe. There was a great difficulty in separating yttria and erbia. There was no difficulty in finding whether yttria contained erbia, but a great difficulty in finding whether erbia contained yttria. He could not say that defendants' fringes were not made of zirconia and erbia, or if made of zirconia or erbia alone. He should say it was made according to plaintiffs' specification. He could not tell whether one made with calcium would be within it; that would be a question of construction for the Court. The distinction between calcium and erbium was this: Erbium was mentioned in the specification, and not calcium. Calcium would not be considered by a chemist as a constituent of cerite or yttrite earth, though no doubt it was generally present. Cerite earth was a mixture of the rare oxides obtained from the raw material cerite; the name stuck to the same substance when obtained from other sources. The patentee drew a distinction between cerite and cerite earths. He could not remember seeing the expression cerite earths until he read the specification. He found the expression in text-books—he believed it was in "Crookes's Bakerian Lectures" on select methods, and in Watts; but he was not positive. He should not regard erbium as an equivalent for the combination of zirconium and other rare earths; it would probably not give so good a result. He could not say that success depended upon getting a suitable blend of these earths; it was highly probable it was so. He did not think he had got mantles which would fall to pieces by using any particular blend; he considered they were all equivalents practically in physical qualities. He had tried many combinations, but not by any means all. Certain limits had to be observed, so as to get a good result. He had the results, or the remains of them, of most of his experiments. He did not try them for a long time, and could not say that they all answered the description in the patent of "a full, large, almost pure white light," &c. Erbia, for instance, gave a green light in certain cases; and some others gave other coloured light. The patentee gave certain directions for the substitution of other materials; and some equivalents were mentioned. He should judge by the result whether a substance was an equivalent. Cerite and yttrite earths differed very much in their composition. Gadolinite contained about 50 per cent. of yttrite oxide, with many other things. Cerite consisted chiefly of cerium, didymium, and lanthanum, with other bodies. He thought any sample of these earths would make a mantle; but it was open to a later inventor to take out a subsidiary patent for specific combinations which would work best, although he did not think he could use them without infringing the original patent. In 1885 the chief metals contained in yttrite earth were known. "Watts's Dictionary of Chemistry" in 1881, dealing with yttrium, gave a list of metals allied to it, such as erbium, didymium, and terbium. The question of the colour of the oxides was of great importance; it altered the emissivity. Dark coloured things had high emissivity; but they did not give so good light, because they parted with their energy so rapidly. As he understood it, a rather low emissivity was required to get a good result. He had never seen philippium; and he believed terbium had now vanished, or become something else. The patentee warned people against didymium, which was coloured; and that would lead one to avoid other coloured oxides. He believed didymium had since been split up into two. A man once consulted him as to the use of samarium for a mantle; but he asked him to bring him some of the substance, and he had never seen him since. He had never seen samarium. Ytterbium he had never seen; but he should judge it would be an equivalent. Several other substances named in "Watts," with very long names, witness had never met with. He should say that, as yttrium and erbium would answer, any other metal of the same group, provided it was not coloured, would answer also. He could not say how many metals in the yttrium group were known in 1885. He was not sure whether one could get a cerite earth with no didymium and little cerium, in Nature. Cerium could be oxidized, he believed, to remove it. He could not say without reference how to remove the didymium. If he had to do such a thing, he should give his assistant a book, and tell him to work at it. Reference was then made to "Abel and Bloxam" published in 1854, with reference to cerium, &c., "D. Graham" in 1858, and to other text-books, to show what was known about them prior to 1885. Several analyses were quoted in which the proportions of didymium and lanthanum were given together; and witness said they probably included other oxides as well.

Justice WILLS said he did not wish to interrupt, but it seemed to him that, if the essence of the patent consisted in taking nitrates of rare earths, and subjecting them to a certain process by which a mantle could be made, then the discovery that one earth would do instead of the combination, would still be an infringement. He understood the great discovery which was said to be the subject of the patent, was that treating a fabric with soluble salts, instead of mechanically coating it, gave a result which could not be obtained in any other way.

Mr. BOUSFIELD submitted that the claim was to a certain process in which certain materials were used; and his friend wanted to say that any substance which would answer the purpose, was an equivalent for those mentioned. That was why he had to go into these matters, to show what was the state of knowledge at the time, and that erbia was not known as a constituent of cerite earth.

Several further passages from chemical text-books were read, which the witness said represented the state of common knowledge with regard to cerite at the time. He could not say that erbia was known to belong to the yttrite group and not to the cerite group. Cerite earth of normal composition, or cerite, if the didymium and most of the cerium were eliminated, would consist largely of lanthanum; almost entirely so, if the analyses quoted were correct. He had never analyzed cerite; and therefore could not say that he had ever found erbium in it. Another analysis was read, in which "traces of erbium" were referred to, as possibly present in cerite. The cerite earths would be understood as meaning the oxides of cerium, didymium, and lanthanum. The constant elements were what he mentioned, with iron and calcium. He could not say erbium was not present. The phrase in the specification would not convey to his mind the substitution of erbium for lanthanum. (A passage from "Gmelin's Chemistry" was read, referring to a network of chloride of calcium, left on soaking paper in such a solution, and then burning, such network becoming incandescent on being heated; and reference was made to experiments, in the like direction, as early as 1820.) Lime was not suitable for mantles, because it volatilized; the same thing probably occurred, though in a much less degree, with the Welsbach mantles. The lime went off quickly, giving a characteristic calcium flame. Probably by experiment a sort of scale could be formed, but there would probably be jumps. Lime was not one of this set; nor magnesia, nor alumina, though they were all earthy oxides. He should call the set the cerite and yttrite earths and zirconia, though that was not, strictly speaking, a rare earth because it was mentioned. The words "rare earths" were not mentioned. He admitted that a much better specification could have been drawn; but he did not admit that it was impossible for anyone to know what he might do, and what not, directly he left the exact words of the specification. He did not agree that, unless one used magnesia, the effect of the ammonia gas was that the mantle immediately fell to pieces. The plaintiffs did not now use any ammonia. The present mantles were better than the early ones; but he did not attribute that to the absence of ammonia. He took great trouble to find out how failure occurred, as described by Mr. Crookes in a former case, but could not explain it. He did find the mantle fall to pieces, except when put into liquid ammonia. He went thoroughly into the question of ammonia, and found it had really no chemical effect, as after a time the primary action was reversed, and one got the original substance again. He tried chemicals obtained from independent sources, in order to try and discover the cause of failure by other operators. He suggested that the latter might have been working with impure chemicals. He had preserved specimens of chemicals

he had used, which he should be pleased to hand to defendants' chemists for experiment. With some chemicals he had a difficulty in burning off the mantles without damage. The ordinary way of burning them now was to begin at the top. He thought the failure of mantles in burning off was due to defective materials. (Another mantle was burned off by the witness, the ignition taking place at the bottom; and it retained its shape. Witness said it had been treated with ammonia.) With very weak solutions, the mantles were very fragile; but there was no difficulty in arriving at the requisite strength. He did not think the burning off made a difference in the proportion of salts left in the skeleton, compared with what were in the solution.

Re-examined by Mr. MOULTON: These oxides were not volatile; any difference in proportion must be due to a mistake in the original calculation. No successful mantle had been made, as far as he knew, without using Welsbach's process, of a solution of salts which were decomposed in the burning. Frankenstein's lamp was described in a German periodical in 1848. He had carefully followed the descriptions given, using both lime and chalk; and he had done his best to succeed, but in vain. He had one in Court which he had made; and there were some made by Mr. M'Kean. Witness burned off one of these in the same way as he had the Welsbach; and it fell all to pieces in the process. All those he made behaved in this way. If the gum were left out, in the case of the lime it lasted a few minutes longer. If Frankenstein obtained the results described, he certainly did not tell the world how to obtain them. Witness was then taken again over the thermo-candle specification, and a good deal of amusement was caused by the great variety of suggestions made. Witness said the specification claimed everything, but did not describe anything. He could not make head or tail of it at all till he read Williams's other specification for an electrical lamp, and that gave him a clue. That explained his strange idea of having a coating of metal outside a refractory and non-conducting core. The electric patent had a consistent idea running through it, though it was founded on a fallacy. But it was wholly inapplicable to the other purpose. There was nothing to tell anyone how to do anything. He could not at the moment think of any material in the universe which was excluded from some of the descriptions.

Justice WILLS asked who Mr. Williams was.

Witness said he never heard of him apart from his specification.

Mr. MOULTON added that he was an American. Coming back to the plaintiffs' specification, he further re-examined upon it. Witness said the invention described was novel at the date of the patent, and the description given was sufficient. He had told two assistants to work according to it; and they did so successfully. The ammonia was no real difficulty—it was convenient in some ways, and depended on the particular materials employed. Cerite earth and yttrite earths taken together included practically all the rare earths, except zirconia and glucinum. All the substances mentioned in the books quoted by Mr. Bousfield were found in cerite and yttrite earths. The analyses read were not complete and exhaustive. The work of determining the presence of all these rare substances began where the analyses left off. In using yttrite earth, a large number of these rare metals would be included. All these oxides had the same physical properties; and in commercial matter, there would be no object in attempting to isolate them. The same answer applied to cerite earths. These earths were obtained now from all sorts of minerals. Yttrium and cerium were the first metals to be discovered; and they were named after the minerals they were found in. (Counsel then read from a lecture by Professor Crookes in 1883, giving a long list of metals found in samoschite and yttrite earth found in America.) Referring to a specification by Mr. Edison, put in cross-examination, he did not think it was practicable; the word "pyroinsulation" was the principal part of the invention, and that had died out. One could not deposit mineral oxides on platinum in the way suggested; and if it were done, they would not become incandescent, and the expansion of the platinum would break the lime or other material used. There had been a great deal of experimental work done in this direction for incandescent lamps, but none had been successful.

Mr. MOULTON here handed up to his Lordship an original Clamond mantle, which one of his witnesses had preserved.

Re-examination continued: There was an enormous difference in the relative size of individual cotton fibres in the plaintiffs' mantles and the pins used in Lungren's lamp. A diagram was put in to show the difference. A structure of threads like the defendants used could not be made except by following plaintiffs' patent. Fahnehjelm's lamp would not be economically suitable for use with ordinary coal gas; he did not think it would be commercially successful. Lime and magnesia were not soluble in water in the same sense as the nitrates used by plaintiffs; they were practically insoluble.

Further cross-examined: There would be from 200 to 500 fibres of cotton in a single thread.

Wednesday, March 11.

Professor *James Dewar*, F.R.S., was the first witness this morning. Questioned by Mr. MOULTON, he said he had examined plaintiffs' specification. The process therein described was novel. Being asked what the invention consisted in,

Mr. BOUSFIELD objected, and submitted that the question was one for the Court, on the construction of the specification.

Justice WILLS thought the question in some form must be admissible; and it hardly mattered exactly how it was put.

Mr. MOULTON then asked in what witness considered this process was in advance of common knowledge of the time.

Witness said it was the first illuminating appliance with a cap or hood made as described, and of the substances mentioned, which included the peculiar group——

Mr. BOUSFIELD again objected.

Justice WILLS said he must allow the witness to give his answer; and he should allow the same freedom to the defence.

Witness, continuing, said he understood the substances mentioned to include the oxides of the rare metals commonly called the oxides of the rare earths. He understood the process of impregnation to depend upon the use of soluble salts, so that the whole fibre of the fabric became impregnated. When a fabric so prepared was burnt off, it left a skeleton of the oxides exactly representing the fibrils of the cotton fibre. This process was essential to success; and he knew of no incandescent light which did not depend upon it, if it succeeded. This process was new at the date of the patent. He had read the description of Frankenstein's process, and tried to carry it out. It would not make a practical mantle; it fell to pieces almost at once—there was no cohesion. The experiment tried in Court yesterday exactly agreed with his own experience. He followed the directions given in "Dingler's Polytechnische Journal," Vol. III., p. 54. He used glue instead of gum, because he heard of Mr. Swinburne's experience with gum. If Frankenstein did succeed in making a mantle, he did not know how he did so. He had also read Williams's specification. Broadly speaking, in his view, it was utterly incomprehensible, and conveyed no information at all, either practical or theoretical. In the electrical specification, he proposed putting the metal outside; and he gathered it was the same in the thermo candle. The whole thing was a farrago of nonsense. None of the alleged anticipations showed the process he had described as essential to success. Oxides could not be successfully applied on the outside of platinum wire; they had very different co-efficients of expansion, which would inevitably cause rupture. The practical directions in the specification of plaintiffs were clear and sufficient. He had tried the Frankenstein method with Welsbach materials. He took the oxides in the proportions named, and mixed them with water and gum, and made a mantle as directed in "Dingler." The moment it was ignited, it fell to pieces. The same materials made an excellent mantle following Welsbach's directions. Ammonia did not injure the mantles. He had made a large number, using ammonia. There was no difficulty in it. At the date of the specification, it was difficult to say shortly the state of knowledge about the rare earths. Generally speaking from the discovery of rare earths at all, yttria was supposed to be one uniform material. The next investigation found it contained another constituent. Then Berzelius took it up and discovered cerium. Then lanthanum and didymium were discovered; and the progress of research had been to extend the number of different metals, all of which were originally included in yttrium. The characteristics of these bodies were very similar, especially from the point of view of this patent. The analyses quoted were not exhaustive. It was a disputed point how many elements there were in a mass of yttria earth. Yttrium, lanthanum, and erbium were all to be taken as compounds. By ytterite earth in the specification, he understood what was said by Mr. Crookes in his Bakerian lecture in 1883, which was printed in the "Proceedings of the Royal Society," and had been reprinted several times. He was dealing with the origin of a particular band he found in the spectrum. He said it belonged to the yttrium family, which was a large one; and then he gave a table of the substances which had been found in samarskite, a mineral recently discovered in North Carolina. Ytterite earth did not connote a mineral having any specific preparation of these rare metals. Some minerals were more complex than others. Cerite earth was similar, and was included in the ytterite earths. "Cerite and ytterite earths" was a generic term. In an analysis in which he found a certain percentage of yttrium stated, he should understand that this represented pure yttrium, so far as the method of analysis enabled it to be done. The witness here described the method of fractional precipitation. Where a body gave a clear absorption line in the spectrum it could be identified, as in the case of erbium and didymium. For the purpose of this patent, such refinements were altogether unnecessary; and the description given was quite sufficient for all practical purposes. In his opinion, there was no practical value in isolating erbium for this purpose. It would be a costly and difficult operation, and would be of no advantage. Up to the present time, it had not been done commercially. After the Court adjourned yesterday, he obtained some of the preparations Mr. Swinburne got from Germany. Among them he found what purported to be erbium from Messrs. Hähn. He analyzed it as far as he could in the time. He dissolved a weighed portion in a known volume of water, and then the same proportion of a material he had seen prepared at Cambridge, which was supposed to be erbium. On comparing them simultaneously in the spectroscope, he found that Hähn's specimen contained didymium, whereas the Cambridge specimen did not. By a further process, he found it gave a precipitate, which pure erbium would not. It was clear, therefore, that it was not a uniform article, but contained other substances. He believed the amount of real erbium in the specimen was small, judging by the absorption spectrum compared to that described by Bunsen, its discoverer. He also tried a sample of erbium prepared by Welsbach, which was the best he had seen. Spectroscopically, it was identical with the description given by Bunsen. Welsbach was Bunsen's assistant, and the man who discovered that didymium was a twin metal. He also experimented with Hähn's specimen of nitrate of yttrium, and found it contained erbium. Yttrium itself had no absorption bands. He had a fragment of a De Mare fringe handed him in November, and examined it, as far as he could, for the purpose of ascertaining whether it contained bismuth or magnesium, and found neither. He then tried to recognize the erbium spectrum, and failed. There was therefore no substantial proportion of erbium present.

Cross-examined: These rare earths were found in various minerals, but the minerals themselves were rare. He could not say there were scores; possibly there were a dozen. Professor Crookes came to the conclusion that yttria was very widely distributed in Nature. He would not go the length of saying that traces of the rare earths were found in scores of minerals. A list given by Professor Crookes of substances in which yttrium was traced was read, in some cases the proportion being one in a million. This was only an inference from the appearance of the phosphorescent spectrum *in vacuo*. The original source of the cerite earths was gadolinite. In some text-books there was a distinction drawn between the cerite group and the yttrite group; but there was no real distinction. It all depended on the opinion of the author.

By his LORDSHIP: There were two classes broadly speaking.

Cross-examination continued: He could only say that cerium, didymium, and lanthanum were originally discovered in cerite, without reference to "Gmelin," or some other text-book. Gadolinite was the original source of the rare earths; but he could not give

the date when cerium was first discovered in it. The amount of yttrite found in cerite was very small. No doubt the predominant constituents of cerite were cerium, didymium, and lanthanum; the other chief constituents being iron and lime. He had no doubt what the patentee meant when he said one might take cerite earth in which there was no didymium and but little cerium. The way in which he would proceed would be to get such mineral of this kind that he could get in largest quantity, and cheapest. He would either get cerite or some other mineral, precipitate the whole group, separate the didymium and cerium, and work with what remained. There were better minerals than cerite for the purpose. On the face of the specification, the author drew a distinction between cerite earth and ytterite earth. He did that to include the whole group. He indicated the use of lanthanum and zirconium, and that yttrium might or might not be added. Then he said instead of using yttria one might use ytterite earth, and instead of lanthanum, a certain kind of cerite earth. He did not read it as meaning that yttrium was optional. He had found that yttria alone would make a mantle. In essence, the discovery was that these bodies could be made to cohere together for the purpose of forming an incandescent mantle of fine filaments. Possibly at this time, cerite earths might be understood to mean a mineral in which cerium, lanthanum, and didymium were predominant; and ytterite earths, those in which yttrium predominated. It did not strike him as remarkable that there was a warning against the presence of cerium and didymium in cerite earths, and not in the case of ytterite earths. Returning to the method of following the patentee's directions for using cerite earths, witness said that he should follow the method described in text-books such as Roscoe's. The insolubility of the oxalates was characteristic of the whole group; and he should precipitate them therefore by oxalic acid. He should separate the calcium and other impurities first. To get rid of the didymium and cerium, they must be dissolved and reprecipitated with chlorine, or in some other way. He would hand in the complete scheme of analysis he pursued. The problem could be attacked in several ways. He suggested this was the kind of thing the inventor contemplated.

By his LORDSHIP: He knew of no natural cerite earth which contained no didymium and very little cerium.

Cross-examination continued: In getting rid of the cerium and didymium, one would not also get rid of the yttrium and erbium. The ytterite group would be left in solution; and the lanthanum would be precipitated with the cerium and didymium. The former would be precipitated from the solution afterwards. Zirconia was not included in the cerite or ytterite group strictly speaking. It stood in a class with thorium. Things allied chemically were not necessarily very similar in their physical and optical characters. Several examples of such differences were given. These oxides were not volatile; the reduction in the thickness of the mantles was due to friction. Lanthana gave a continuous spectrum, and gave a substantially white light; didymium, dull reddish light; cerium, the same. Yttria gave a white light. Erbia was the only one giving a discontinuous spectrum; and it gave a greenish light. Erbia was discovered by Bunsen in 1866. There were about 21 rare earths of the ytterite family now known, as given by Crookes. Columbium and decipium he could not speak of. Mr. Crookes called zirconia a rare earth, and he should adopt that name; but it was not now classified with the other oxides of which they had been speaking. In making mantles, the proportion of the rare earths was of importance, he understood. The durability of the mantles might be affected by the particular combination used; but he did not know it of his own knowledge. They doubtless differed in cohesive power. He was not aware that pure thorium gave a mantle which was practically useless. He had seen the specification of 1886; Welsbach there described a mode of making a mantle with pure oxide of thorium.

Mr. MOULTON again objected to the introduction of a subsequent specification.

Mr. BOUSFIELD said he should be quite willing to defer these questions until Baron von Welsbach was called.

Mr. MOULTON said he was not going to call him.

After some discussion, his Lordship said he could only take the evidence of the witness as to his own knowledge; the specification could not be treated as evidence in any way.

Cross-examination continued: Witness had not separated all the various metals of the group, and could not say what coloured light they would give. They all gave a white light, except erbium. On being pressed with the individual metals, he said he had not tried them. He had no doubt they would each give a white light if tried separately, because yttria, mixed with any of them, gave a white light. He could not say because yttria containing a mere trace of terbia gave a white light, that therefore terbia alone would give a white light. A scientific man could not draw such an inference from a mere trace. Frankenstein described a tissue to be impregnated with earthy oxides, which fabric was to be burned and leave a skeleton. According to the description, he succeeded to a certain extent. He did not think this was a very long step towards the solution of the problem; but it was a step. The merit of Welsbach was that he got a coherent reticulated mantle. He knew Fox Talbot. It was a question of construction whether paper was a fabric. His experiment was well known; any tissue of organic material might be burned, and left an ash which would be luminous when heated. Though he knew Talbot's paper, it never occurred to him to utilize it as Welsbach did. He had never tried a paper cone; but he should think it would fall to pieces. Referring to Williams's specification, paragraph 39 was clear as far as it went. There was no novelty in soaking muslin in a solution of a salt. He suggested the use of an organic material, on which something might be deposited; the organic material to be afterwards burned away. If one stopped at a certain stage, there would be something analogous to a Welsbach mantle; but his object was evidently to obtain a metallic coating for the purpose of giving light. He had not made a quantitative analysis of defendants' fringe; he only found what was not there. He found no erbia, nor magnesia. Witness described how he tested spectroscopically for erbium, and showed his Lordship the spectrum as found by Bunsen. Erbia was discovered about 1843, and Bunsen's paper was published in 1866. Since then he did not think there had been a further differentiation of erbia as isolated by Bunsen; but further substances had been found in ytterite earths: He met with no failures when using ammonia, and could not account for such failures in the hands of others.

Re-examined: There were no instructions in the Frankenstein papers which enabled a mantle to be made and burnt off, leaving a coherent mantle. As he read the plaintiffs' specification, the substances mentioned in it were the constituents of cerite and ytterite earths, with the addition of zirconia. The real chemical discovery was getting the coherent skeleton by the decomposition of the soluble salts. All the metals which had been spoken of were substances more or less alike in physical properties, such as the power of the oxides to withstand volatilization at high temperatures. Apart from slight differences of colour, he had not found any appreciable difference in various combinations. With regard to columbium, he did not believe there were 10 drachms of it in the whole world separated. The same applied to decipium, and most of the others. There were two kinds of yttrium; but they were not really known commercially. This patent had led to the discovery of new sources of supply of the rare mineral earths. The chief source was monazite sand found in Brazil. The only use of any of these oxides, previous to Welsbach's patent, was of one of the salts of cerium in medicine. A large industry had now grown up in Vienna in the preparation of these substances; the material coming from America. The percentage of some of the minor constituents varied considerably in various samples. In all cases, erbium only existed in very small quantities. It had no properties making it worth while to isolate it. Samarskite was a well-known source of ytterite earth. In his opinion, the wasting of mantles was not due to volatility, but to gas friction at a high temperature—there was considerable attrition. If a substance were volatile, it would give a distinct spectrum which could be recognized. He tried experiments on the cohesive power of all the earths he could obtain separately, and found no substantial difference in them in this respect.

Mr. *W. H. Y. Webber* was the next witness called, and examined by Mr. WALTER. He said that he was a gas engineer, and chief of the editorial staff of the "JOURNAL OF GAS LIGHTING," which circulated amongst those interested in gas matters all over the world. In that position, he had to make himself acquainted with all that went on in connection with gas lighting. Previous to the year 1880, the only incandescent light he was acquainted with was the old lime-light. In 1880 incandescent electric lighting came in, and created a market for improved gas-burners, which could scarcely be said to have existed previously. As the result of the Electric Exhibition of 1880 at the Crystal Palace, there was an International Gas Exhibition in the winter of 1882-3, where every kind of practical gas-burner, and some which were not very practical, were shown. He prepared a pamphlet intended as a popular guide to the Gas Section of the Exhibition, in which he dealt with all that was known at the time. It never occurred to him then that the subject of incandescence required discussion. Gas engineers were then devoting themselves to improving gas-burners by emulating the electric arc light; and at that time an improved gas-burner was almost synonymous with one of very high power. Several principles were employed; but the simplest and readiest way of improving gaslight was to multiply the number and increase the consumption of well-known forms of burners, which was done largely both with argand and flat-flame types. But, in addition to this, a totally new system was then coming out, some of the earliest examples of which were shown at the Exhibition referred to. This was called the regenerative or recuperative type of burners, in which a high illuminating power was obtained by previously heating the air and gas by the otherwise waste heat of the products of combustion. Up to the time of the Exhibition, he had seen nothing in the way of an incandescent gas-burner; but there were then shown both the Clamond magnesium basket light in the China Court, and also one called the Lewis induced-blast platinum light. This consisted of a platinum basket on an upright burner. It was a very unpleasant thing, as there was an odd hissing noise, and the light emitted, though powerful, was of a very bad colour—reddish. The gas was not supplied under pressure; but the air pressure was something considerable. The Clamond burner was one of the inverted type, with the light issuing from a magnesium basket below; but he was not sure they did not show some of the vertical type also. The character of the light was exceedingly pleasant; and it was recommended, at the time, more on account of its good colour, especially for use in drapers' shops for matching colours. It was the first gas-burner which produced what could really be called a white light. He could not identify the Clamond basket produced, as he thought the one he saw was larger. He knew that these baskets were exceedingly fragile, and did not think that the inventor claimed that they would last more than 12 or 15 hours at the outside; so that practically it would probably require a fresh basket at each time of lighting. There was a forced draught, but the pressure was not so high as he believed the Lewis blast light was. The standard text-book on the subject of gas lighting was "King's Treatise on Coal Gas." The edition of 1882 contained no reference to gas lighting by incandescence. He had heard of the Fahnehjelm burner, but never saw one. It was never introduced as an ordinary lighting appliance. He had heard of it in connection with the lighting of factories where non-illuminating water gas was made. He had made no test of the efficiency of the Lewis or Clamond lights; it was not his habit to make tests himself, he always relied on reports made by experts. There was a Committee appointed for gas-burners at the Exhibition; and they issued a report giving the duty of both types of incandescent burners. Both were distinctly superior to a common flat-flame burner, but were not so good as the new recuperative lamps of the Siemens type. He believed the Lewis came out rather later than the Clamond, which made one think that if one could get over the red colour of the platinum light, it was more promising than the magnesium. He remembered when the Welsbach burner was introduced; he read of it first in a German technical journal at the beginning of 1886. At first he reserved judgment, leaning towards scepticism, as he had no belief that there was any prospect of getting good results by that road. His present opinion was that it was the best light for domestic purposes.

Justice WILLS said he understood there was no doubt about that.

Mr. BOUSFIELD said he wished witness would distinguish between

mantles made according to the 1885 patent, and those made under subsequent patents.

Examination continued: The first definite information he gathered about the value of the Welsbach light was from a paper read before the British Association in 1886, which stated the duty at 9 candles per cubic foot—a degree of efficiency which, at that date, was unheard of for anything of the kind, though it had been approached by the best Siemens recuperative lamps, which were then all the rage. He had no doubt the attempt of Clamond to make his lamp an inverted one was due to his desire to emulate the Siemens light. With the advent of the Welsbach, the fortunes of the regenerative type went down. He would not say the Welsbach light had replaced the regenerative type of burner altogether. It was still largely used as a high-power burner; but, as regards domestic lighting, the incandescent burner had knocked out every other kind of improved light. With regard to its use in other countries, he could simply speak as matter of repute.

Mr. BOUSFIELD said he did not contest the success of the incandescent light. His contention was that mantles made under the 1885 patent were a failure; and it was only by subsequent patents that they had been made a success.

Cross-examined by Mr. BOUSFIELD: He did not know anything about the manufacture of the mantles, and could not say whether they were now made under the 1885 or 1886 patent.

Mr. *John Imray*, examined by Mr. TERRELL, said he had carefully gone over the specification of Welsbach and the alleged anticipation. He was not a chemist; but as an engineer, his opinion was that the invention consisted in the process of producing a highly attenuated fabric of metallic oxides in the manner described. The invention was quite a new departure. The mantle as made under the 1885 patent was a great success; it did not come into general use, owing to difficulties connected with the Company, nothing to do with manufacture. He and Sir Frederick Bramwell made a number of experiments on mantles made under the original specification, which he narrated in detail. The materials used were prepared by Mr. Mactear, and what remained of them was analyzed by Professor Tatlock. The description in the specification was carefully followed. Fairly successful mantles were produced. He had read Cruickshanks' specification. The pastes he described would not adhere to platinum, and if they did, they would crumble on heating. Witness drew all Clamond's specifications; and he did not consider they anticipated Welsbach. There was no idea of using a solution to impregnate a fabric and then burn it off. The same answer in general applied to Frankenstein. He had read Williams's specification about twenty times, but had never come across such an unmeaning specification in all the thousands which had come under his notice.

Cross-examined by Mr. WALLACE: He had seen the infringement, the cap or hood. It was a collection of threads; they were not woven together. He called a fringe a fabric. A fabric meant something put together, not something woven; that was a texture. He looked upon a thread as a fabric. He drew the specification in question. It did not occur to him then to use single threads, or that threads were included in it. The intention was to describe something in the nature of a cap or hood. He had in his mind something woven or knitted. He could not say it was intended to always use a chimney; but a chimney was certainly contemplated. Any suitable form of burner was mentioned. A bunsen burner was found to work best. The defendants' burner was of a different shape; but he had not seen it in operation, and could not say whether the same portion of the flame was utilized as in the round bunsen burner. He could not say whether the defendants proposed to use a chimney. When he drew the specification he did not know much about ytterite earths. In his experiments he tried a mantle of half lanthanum and half yttrium. It produced an incandescent mantle; but he could not say what the illuminating power of it was. He was satisfied if it became incandescent and would stand. They watched the mantles for three or four hours. He kept no record of the amount of gas consumed. He had not seen the mantles since they were left at the works. The materials were supplied them in phials, which were afterwards sealed up. He could not say the strength of the solutions; probably about 15 per cent. It was not a saturated solution. They took the proportion named in the specification of the solutions furnished them. His view was that if one took the proportions approximately, that was sufficient. It was a mechanical operation rather than a chemical one. He believed that at first there was great difficulty in obtaining the substances required, but not in making the solutions when they were obtained. It was only of recent years the Company had been a success. He had been told that the success was largely due to the use of thorium; they found that a very good thing. He did not know what the mantles were made of now. The experiments conducted by himself and Sir F. Bramwell were entirely directed to seeing if mantles could be made by following the directions in the specification. Witness had no samples of ytterite earth to deal with, or cerite earth. He did not satisfy himself that there was no didymium present, nor did he know the object of having no didymium. He simply drew the specification according to instructions, which were written in German. He had looked for them carefully, but in vain. He could not say the object of using ytterite earth. He considered the oxides included all the substances mentioned—"mentioned" meant what was brought to one's mind as well as what was specifically named. They used ammonia; but he did not know the object of doing so, nor did he inquire. They used it because of the directions in the specification. A mixture of magnesia and zirconia was also tried. The date of these experiments was June 18, 1894.

Thursday, March 12.

Mr. *Imray* was further cross-examined by Mr. WALLACE. He said he had been informed that the ammonia decomposed the nitrates into hydrated oxides. He could not speak of his own knowledge. He cut the fabric in strips, sewed it together, and drew it together at the top, as directed in the specification. It was burned off in several ways. It was rather better beginning at the top; some mantles fell to pieces on being put over the gas-burner. The mantles shrank a third or fourth of their length; but he did not measure them. There was a little variation in this respect, according to the solution used. These mantles were intended to be used with any form of burner which was suitable. Welsbach mentioned an expedient to prevent tearing the fabric, by adding stronger threads. This must have been meant to apply to a woven fabric, not to single threads. He did not think he had single threads in his mind. The claim was not limited to any particular kind of fuel; it said "gas or other burners." This was very general; but not so general as Williams. He did not say "cap or hood" covered every possible form, but any form which was suitable. The "substances mentioned" included the nitrates or acetates of the oxides of the metals named, and ytterite earths and cerite earths. He should not exclude the alkaline earths if they were suitable; but should include everything which would answer the purpose. The patent was not for any chemicals, but for a way of using the chemicals. Witness was then cross-examined on Williams's specification; but he adhered to the opinion that it was absolutely unintelligible. [Counsel then read certain passages from the description of Frankenstein's apparatus, which he suggested were parallel to passages in plaintiff's specification, to which the witness agreed.] He should not call Clamond's cage a fabric, only such things as were capable of being impregnated and saturated. In the trial before Mr. Justice Romer, he did not understand that the case was confined to the materials used. He could not remember; it might have been so. He was not responsible for it. His own view had always been that the patent was for the mechanical process.

Re-examined by Mr. MOULTON: The experiments he made with Sir F. Bramwell were for the purposes of the former trial. They were carried out with great care; but he made no analysis. Mr. Tatlock analyzed the materials, and gave evidence before Mr. Justice Romer. He knew the Clamond inventions, and also the platinum caps. The experimental mantles he produced in conjunction with Sir F. Bramwell were a great advance on anything that had been seen before. Since then he had seen thousands of incandescent mantles, but never one in which the method described in the specification was not followed, apart from the use of ammonia and the stitching. The patentee referred to impregnated threads in his specification.

Professor *Dewar* was recalled for further cross-examination on some points which Mr. Bousfield had asked leave to defer on the previous day. He heard Professor Crookes's lecture which had been referred to; but he had not read it since. He had communicated several subsequent papers to the Royal Society and the Chemical Society, dealing with the spectroscoping of the rare earths. A clear distinction was not drawn in those papers between the cerite and ytterite groups as far as he remembered.

[Counsel then read certain passages from the Bakerian lecture; but witness did not agree with the interpretation suggested. Mr. Bousfield, with the consent of his Lordship—Mr. Moulton not objecting—said he would deal with the matter in his speech; the whole lecture being treated as put in for that purpose.]

Witness was then referred to Dana's work on mineralogy, and a note to one constituent in an analysis Y_2O_3, which said this group included the yttrium earths. He did not agree with the interpretation put upon it. He did not recognize any difference between ytterite and cerite earths.

Re-examined: In the last edition of Roscoe and Schorlemmer, 1893, under the title of metals of the cerium group, yttrium, erbium, and the whole of the rare metals spoken of were included. Three new metals had been added to the group since the previous edition.

Further cross-examined: In the same book, copper, silver, and mercury were embraced under the copper group.

Mr. *J. E. Lowenthal*, managing clerk to Messrs. Faithfull and Owen (the plaintiffs' Solicitors) was called to prove the receipt from defendants Solicitors (Messrs. Abrahams) of six fringes such as defendants proposed to make. One of the six was sent to Mr. Tatlock, of Glasgow.

Mr. *Horatio Ballantyne*, analytical chemist and chief assistant to Mr. Tatlock, was the next witness—Mr. Tatlock being now in South Africa. Witness analyzed the fringe sent by plaintiffs' Solicitors. He examined it microscopically, and then photometrically. It was composed of flax fibres. He put a flat-flame bunsen burner under it and lit it; the organic matter was consumed, and left a skeleton which became incandescent. The highest photometric result was 3·65 candles per cubic foot of gas consumed. He took the ash back to the laboratory and tested it. When examined microscopically, it was coherent, and retained the structure of the original fibre. On chemical analysis, he discovered a trace of sulphates, but no bismuth, or any similar metal. He found zirconia, but no thoria; and there was no indication of erbia tested spectroscopically, but the quantity was very minute. The rare earths present were the oxides of the yttrium group. The quantitative analysis was: Oxide of zirconium, 83·81 per cent.; yttrium group, 9·39 per cent.; magnesium, 6·51 per cent.; and sulphuric acid, a trace.

Cross-examined: The total weight analyzed was 0·86 of a gramme. The total quantity of yttrium earths was about 8 milligrammes. If this had been erbia, it would have been readily perceptible. He did not agree with Professor Crookes that this spectroscopic test was not a very delicate one. He could not say what the particular constituents of the yttrium group were; but they were not lanthanum, cerium, or didymium. Subsequently, there were none of the cerium group. The distinction between the cerium and yttrium group was well known to analytical chemists. He knew Mr. Mackean. He did not know that he had seen his analysis, which, according to the letter to Mr. Tatlock, Messrs. Faithfull and Owen were anxious to have verified.

Re-examined: He made a perfectly independent analysis; he knew nothing of Mr. Mackean's analysis. He was quite capable of weighing 6½ milligrammes; the probable error would not be more than ¼ milligramme. He described the method of analyzing for rare earths. The division into the cerium group and yttrium group was for convenience of analysis, one being precipitated from solution by sulphate of potash, and the other not.

Mr. TERRELL then put in certain answers to interrogatories, in which the defendants said they proposed to construct and sell plumes for incandescent lamps of the materials and in the manner described in the affidavit of Mr. De Mare and Mr. Franchet. In that affidavit he said the invention consisted of three parts—a gas-injector, a new gas-

burner, and a radiating tissue of the shape of a plume, which might be steeped in any solution of salts capable of emitting light by incandescence. He further said the substances he used were the sulphates of zirconium, erbium, and magnesium. He also put in the cross-examination of Mr. Franchet, on commission, and the three De Mare patents of 1894-95.

Mr. BOUSFIELD objected to the patents being read, as defendants did not propose to use everything in the patents.

His LORDSHIP said the patents being referred to in the affidavit could be read. What importance was to be attached to them was another matter.

Mr. TERRELL then read defendants' patent of 1895. He next read further extracts from the answers to interrogatories, which said it was the intention of the defendant Company to make and sell plumes as described in the patents.

Mr. MOULTON said one of the six plumes still remained intact; and if there was any question as to their composition, he should be willing to have it analyzed by any two or three gentlemen agreed upon.

Mr. BOUSFIELD said if Mr. Mackean (the plaintiffs' chemist) were called, it might prevent any such necessity. If his friend did not call him, he should perhaps do so himself.

Mr. *W. R. Cooper*, the next witness, said he was assistant to Mr. Swinburne. He received plaintiff's 1885 patent with instructions to make mantles in accordance with it, in conjunction with another assistant—Mr. Beadle. That was on Jan. 2 last. Up to that time he had given no attention to incandescent lights, or rare earths. The materials supplied to him were oxide of lanthanum, nitrate of zirconium and some ytterite earth. He had no instructions beyond those contained in the specification. The mantles were made accordingly; and they gave a very fair light.

By his LORDSHIP: Some were burned a good many hours, perhaps 20 or 30.

Examination continued: They behaved well all the time; there was no reason to think that their life was then exhausted. He had to go and buy what materials he required beyond those above mentioned. He tested the chemicals supplied, and found they were substantially what they were represented to be.

Cross-examined: Witness had the materials which were left. He used very little ytterite earth; and that he did not test. The chemicals came from the plaintiff Company as far as he knew. He had met Mr. Mackean. He (witness) had no thorium; but he knew the methods of separating it from zirconium. He tested the zirconium nitrate for thorium; but not the oxide of lanthanum, because there was no necessity. He obtained no precipitate with sodium sulphate, which excluded thorium. He had no previous experience with the rare earths. He satisfied himself of the purity of the lanthanum; he did not trouble about traces only. He was not familiar with Mr. Mackean's experiments. He did not know that a trace of cerium was of considerable importance in conjunction with thorium. He did not examine any of the mantles photometrically, or compare them with those in practical use.

Justice WILLS asked if this point was of any importance. It might be assumed that the mantles had been improved by experience.

Cross-examination continued: Witness used ammonia; he found it decidedly beneficial. In its absence, the mantle generally went wrong.

Re-examined: The free acid had a tendency to rot the material. He satisfied himself that, for all practical purposes, the materials were what they were represented to be.

Mr. *J. Beadle*, who assisted the last witness in his experiments, gave similar evidence.

Mr. *Dugald Clerk* was next called. After stating his qualifications, he said he had for many years paid special attention to the combustion of gas for lighting and other purposes. He had read the patent and the alleged anticipations. He knew of many of the prior attempts to obtain light by incandescence. Practically, none were of any use, except the lime-light for special purposes. He saw the Lewis platinum cap and the Clamond lamp. Neither was successful, though very interesting. There were two causes for the failure of platinum. One was that it gave out but little light until close to the melting point; it also had a tendency to combine with carbon in a flame, which destroyed it. He had tried a cap such as Lewis used dipped in a cream of lime, and found that immediately the lime was heated, the expansion of the platinum caused it to fall off, except where held in the mesh; and there it reduced the illuminating power. The little Clamond cage produced was similar to what he saw at the Crystal Palace Exhibition. Bearing in mind prior knowledge at the time of the patent, he considered the Welsbach invention, which distinguished it from all previous attempts, was the saturating a fabric with solutions of materials which would be coherent and incandescent on the application of heat, after the organic foundation had been burned out. The directions were sufficient, and the invention was of great practical importance. What he had described, was present in all the incandescent mantles he had seen. In the process of making, apart from the materials, there was no difference as far as he knew. It was convenient to use ammonia; but it was not at all essential. After ignition, it made no difference whether it was used or not. Broadly speaking, the only change in the manufacture of the mantles was in the materials, using a larger quantity of thorium than must have been present in the original mantles. He saw some of the earliest mantles. They were very good; and a great improvement on anything which had gone before. The manufacture was not a very elaborate process; in fact, one of the simplest he knew, and very inexpensive apart from the cost of the material. He had tried it himself, and been successful. He had made mantles using the exact proportions mentioned in the specification, except the one in which magnesia was included. The blends named gave excellent mantles, which, as far as he knew, were durable; but he had not tested them for a particularly long period. The previous night he made mantles according to the specification, after carefully testing the ingredients. He had tried to follow the description of the Frankenstein apparatus; but he found the lime fell to pieces immediately, just as was shown in Court. As he read the specification, the substances were the separate oxides mentioned, and the mixtures alluded to under the expressions ytterite earth and cerite earths, and also magnesia. Ytterite earths would be the oxides produced from a mineral in which yttria predominated; and cerite earths, the oxides of metals from a mineral in which cerium predominated. Among chemists, the cerium group included both the cerium and yttrium groups; the latter being a sub-division. One class was thrown down by sulphate of potash, while the other remained in solution; but there was a little overlapping. It was almost impossible to distinguish between the different members of the sub-groups. Thorpe's "Dictionary of Applied Chemistry" supported this view. There was no broad distinction between the two groups. Different specifications of ytterite or cerite earths would yield different results on analysis. All the oxides of the cerium group, in the broad sense, were refractory, as far as his knowledge went.

Cross-examined: He did not suggest that the patentee meant the same thing by cerite earth and ytterite earth. He was drawing a distinction between them. The ytterite earth was an optional element in one of his recipes. He had only given general, not minute chemical, directions. He believed there was one analysis of cerite earth in Dana, which contained a considerable proportion of yttria; but that was after the date of the patent. The witness was then cross-examined on his statement that the process of manufacture had not been changed, and referred to Welsbach's 1886 patent. He believed the change in the materials was important from a photometric point of view. He did not know how far the discovery of thorium contributed to the success now achieved. Thorium would come down with the cerite group from some minerals. In the 1886 patent, the author stated that subsequent researches had shown him that other substances than those mentioned in the earlier patent, would give successful mantles. He did not consider that this statement cut him off from using any of the substances under the first patent. The particular mixture was of importance, having regard to the colour of the light produced. At the date when the patentee was filing his complete specification for the 1885 patent, he already had the knowledge that different colours were produced by different oxides. In the 1886 patent, the statement was made that the whole of the materials need not be in solution, but might be in a finely divided condition. He did not know whether this variation was practically followed; but it would not, in his opinion, affect the mantle.

His LORDSHIP again interposed to suggest that cross-examination to show that the mantles had been improved since the first patent was not very material. He should assume such would be the case, and it would not invalidate the early patent.

Cross-examination continued: Witness would not be surprised to find that a small difference in the proportion of some ingredients might make a considerable difference in the result. In Moeller's patent of 1893, it was stated that the oxide of thorium gave little light when incandescent; but when it had a very small proportion of certain other oxides, it had a high illuminating power. He had no knowledge of his own on this point, but was prepared to accept the statement. Mr. Mackean was an authority on this subject. If he said that, by altering the composition of the solution, the light could be greatly changed in colour, it was probably correct. It was desirable to have a light with a slight yellowish tinge. Niobium was one of the rare earths, but was not included in the groups mentioned in the specification. With regard to the duration of the mantles, the composition was of importance; some blends being more successful than others. [Several other portions of a paper read by Mr. Mackean before the Society of Chemical Industry in 1891 were quoted, to show the great difference in durability, colour, and photometric power of mantles, according to the materials used; but witness was unable to either confirm or contradict the statements made.]

Mr. MOULTON said this paper must not be taken as evidence against the plaintiffs, because they had reason to believe that some of Mr. Mackean's statements were incorrect.

Cross-examination continued: He could not say of the Welsbach patent of 1885, as he did of Clamond's, that it was interesting, but a failure. One of the mantles made last night, was perfectly successful photometrically. He was at work a great part of the night; but he did not think he made any mistakes in his analysis of the chemicals. They were obtained from the plaintiff Company. He agreed that the rare earths were analytically divided into two sub-groups; he would not say they were naturally divided so. In many minerals the two sub-groups were found in about equal proportions. In 1885 the cerium group included many metals besides cerium, lanthanum, and didymium; some were mentioned by Crookes. He did not think samarium was the only one. He thought anyone in 1885 who wanted to carry out the specification, would not think it necessary to obtain any other mineral as a constituent of cerite earth than the three metals above named.

Re-examined: The differences between the various rare earths were very slight and most difficult to appreciate. People were now fastidious about incandescent lamps; but that was all due to Welsbach's invention. There were bluish whites and yellowish whites as in paper and other articles. What was called the white part of a gas-flame was yellowish; the arc light, though really white, was called bluish. He understood the use of thorium improved the mantles; but this did not show that the original mantles were in any way failures. Erbium was found in ytterite and cerite earths; sometimes in fairly large proportions. It was not, therefore, excluded from the specification. He had used ammonia in all his experiments, and found it gave no trouble.

Professor *Carlton J. Lambert*, the next witness, said he had devoted attention for the last ten years to the subject of artificial illumination, and had seen all the new inventions which had come out. He knew both the Clamond and Lewis inventions; but neither of them was practically useful for domestic lighting. They required high air pressure. One of the Lewis burners used an induced air draught; but it was a clumsy contrivance. The Clamond burner produced was one given him at the time of the Gas Exhibition of 1882-3. He remembered the Welsbach burners coming out; and he had three or four for trial almost immediately. Three of them were mounted and attended to by the servants. They burned for fifteen months, and were fairly efficient at the end of that period. The burner was a great improvement on anything previously existing.

Cross-examined: It was in 1887 that he had the mantles he referred to. He did not know whether they contained thorium. He knew nothing about the chemistry of them.

Mr. MOULTON here produced the ytterite earth spoken to by Mr. Ballantyne and Mr. Swinburne. He had received it from Mr. Mackean. He believed, at any rate, it came from the plaintiff Company.

Professor *Swinburne*, in answer to his LORDSHIP, said this was not a natural earth; it was a chemical preparation.

Mr. MOULTON produced specimens of the chief minerals from which the materials were obtained, including monazite sand.

Friday, March 13.

Mr. *R. L. de Fonblanque* was the first witness this morning. He said he was Secretary of plaintiff Company, which was formed in March, 1887. There was a prior Company, from which the present Company bought the English patents. He took over from the former Company certain bottles of fluid, two of which he handed to Professor Swinburne the previous night. Since March, 1887, the Company continuously sold mantles which gave satisfaction. The early mantles were made from the solution in the bottles taken over; but afterwards they obtained the material from Vienna.

Cross-examined by Mr. JENKINS, witness said he knew nothing of chemistry, and could not say the composition of the fluids used by the Company. The Company was commercially successful from the first; but it was not always prosperous. At one time, it nearly came to grief; that was in the latter part of 1889. He was called as a witness in the action against the Deimel Company; but he did not know he then said that to his knowledge the Company had made mantles according to the 1885 patent. He had been told by the Directors or the officials (not Mr. Moeller) that at one time, in 1887, the Company were unable to get thorium. He was not then connected with the Company; but it was common knowledge among the officials. It was not the fact that the mantles made without thorium were a great loss to the Company. A quotation from witness's evidence in the Deimel action was read, which he said he had no doubt was accurate. He there said that, when the thorium was omitted, the public soon found the difference; and the Company suffered loss in consequence. There had always been occasional complaints, even down to the present day. He did not recollect the evidence of Mr. Moeller at the Deimel trial. If he said the presence of thorium made a marked difference in the light, he did not remember hearing it.

Re-examined: Witness had no personal knowledge of the composition of the fluid; but the first mantles made gave great satisfaction.

Professor *Swinburne* (re-called) said he received two bottles from Mr. Fonblanque the previous night; and they did not appear to have been opened for a long time. He made mantles with the fluids; and also analyzed the latter. One (labelled "white") contained zirconia and lanthana, or something he did not distinguish from it. The other (labelled "yellow") contained zirconia, lanthana, and a small trace of cerium. He made mantles with the fluids, and tested them by the photometer. They were good, and with a consumption of 3·6 cubic feet of gas per hour the fluid marked "yellow" gave a light of 30 to 32 candles, and the one labelled "white," 25 candles. He did not notice any appreciable difference in the colour of the light. The light given by mantles made from any of these materials was substantially white; various blends gave different tones of white. He had seen the experiment with ammonia re-tried. He took a great deal of trouble in trying to find out how to fail with ammonia, but could not succeed. He had tried experiments on the Fox-Talbot principle; and was prepared to show the results.

Cross-examined by Mr. BOUSFIELD: He had read Welsbach's 1886 patent. It stated that certain mixtures would give yellow, orange, and greenish lights. He called them different tones of white light. So far as he knew, he was not colour-blind; but his sight had never been tested for colour-blindness. In one patent, there was the prescription for a pure white light; in the other, prescriptions for different shades. The words "yellow" and "white" on the bottles he received did not apply to the colour of the solution, but to the light produced. The solution with the cerium would no doubt give a slightly yellowish hue, though he did not notice any difference. No doubt between 1885 and 1887, a good deal had been done in the investigation of these rare earths. On analyzing the solutions, he found the oxide, other than zirconia, belonged to the lanthanum or cerium group. There was nothing of the yttrium group, and no thorinum. There might have been some of the out-of-the-way metals like scandium; but he did not think there was any erbium.

Mr. *A. Pringle* said he had experience in microscopy. He verified the photographs which were produced of the mantles in various stages of the manufacture. The visual effect of impregnating such fabrics with solutions was *nil*. When they were burned off, they shrank; but the body remained the same, even the twist of the strands was preserved in a remarkable way. The longer they were burned, the more they shrank; and the more hard they were made, the less brittle they became. With regard to the ultimate structure of the fibres, the fibres themselves were destroyed; but the simulacrum of them remained. He had tried an experiment to see whether substances not in solution would stand in this way. He only had three common oxides at hand, which he tried—lime, magnesia, and alumina. He thought he was following Frankenstein's description; but he found afterwards he did not do so accurately. He rubbed up the materials into a thin paste; dipped threads into it; rubbed them well; and then dried them. He then teased out the ultimate fibrils, and examined them. The threads on the exterior were clogged with the oxides, and the outsides of the ultimate fibrils; but the interior, as far as he could determine, was unchanged. He then tried a mixture of mustard, and proceeded in the same way, and with the same result, except that he was more certain than before that the mustard had not penetrated the inside of the fibrils. Going back to the oxide-treated threads, he found, by passing one quickly through a bunsen burner burning gently, he could catch the *débris*. He could not describe it exactly. It was longer than it was broad; but there was no trace of a thread, or a structure of any kind. These experiments were made spontaneously for his own information. The first Welsbach mantles he had were at the end of 1887 or the beginning of 1888. He introduced them as an ordinary household illuminant, and had used them ever since. One of the first he had burned for a whole year in his laboratory.

Cross-examined: He knew what the fibrils of silk were like. He did not know that they were practically impermeable to a fluid; but it might be so. He did not know what the mantles he had were composed of.

Mr. MOULTON said he was prepared to show the experiment with ammonia, using two mantles—exposing one to ammonia, and the other not.

Justice WILLS thought he must take the evidence that had been given.

Mr. MOULTON said he should desire to show the experiment, because he had seen it himself the previous evening; and a mantle treated with ammonia went to pieces, while the other did not. He did not see that any experiment would be conclusive, unless they knew exactly the composition of the solutions. He suggested that some materials should be obtained from an independent source, and then have the experiment performed; or they might exchange solutions.

Mr. BOUSFIELD said the only difficulty was that his clients had a very small quantity of the solutions left. He would bring the bottle into Court and let plaintiffs experiment with it.

After some further discussion,

Justice WILLS said he must leave both sides to take what course they thought fit, as they could not agree. He was not prepared to say how far he ought to be guided by the result of a single experiment.

Mr. MOULTON said, that being so, this closed his case, subject to putting in formal proof of the validity of the patent having come in question in the former trial, and to his asking leave to call further evidence at a later stage to clear up any point on which his Lordship might desire further information.

Mr. BOUSFIELD then opened the case for the defendants, which he said was—notwithstanding the recondite character of some of the operations and principles—a very simple one. The principle was very plain. Though on both the law and facts, he should have to deal with the matter at some length, he thought the decision would depend more on books and documents than on evidence given in the box. His friend on the other side said this was an invention which changed the course of the world's history; and he suggested that this ought to affect the construction of the specification. He (Mr. Bousfield) demurred to that statemententirely. The principles to be applied to the construction of the specification were independent of the magnitude or otherwise of the invention.

Mr. Justice WILLS said he had not many authorities to support that principle.

Mr. BOUSFIELD said it had been distinctly laid down recently by the House of Lords in the cordite case. The patentee from whom plaintiffs purchased had taken the benefit of a long series of suggestions by others; and though he was the first to produce a practical mantle of this kind, yet the difference between what he had done and some previous inventions was not much greater than between the 1883 patent and the subsequent ones. He (Mr. Bousfield) should show that it was a commercial failure. If this were a patent for the use of any rare earth which would make a mantle, he should submit it was invalid; but on any fair construction of the patent, he did not contend that it had been anticipated. The Frankenstein was in principle the same as the Welsbach, the whole difference being that he used an insoluble mixture instead of a solution. The result was poor, and the life of the mantle ephemeral; but there was the thing in principle. Stokes Williams, again, did not deserve all the fun that had been poked at him. He suggested taking a fabric and steeping it in a bath upon a form which might afterwards be destroyed by heat. He (the learned Counsel) held in his hand a piece of muslin which had been steeped in chloride of platinum, as an illustration of how this could be carried out. Another one was a similar fabric coated with platinum electrolytically. He referred also to salts or oxides; and he produced a sample made with zirconium. Several other specimens of mantles made in accordance with some of the descriptions in Williams's specification were submitted to his Lordship's inspection. Such mantles gave a very fair light indeed, though nothing like equal to a modern Welsbach. He did not set up these as actual anticipations, but only as throwing light on the question of construction. The patentee described a compound of two specific things—lanthanum and zirconium, or those with yttrium, which gave out a large almost pure white light, and did not deteriorate. Certain elements of the compound were indicated as optional, and others as necessary. He gave the proportions, including yttrium, and about half each of zirconium and lanthanum. There was no question so far of equivalents, but afterwards he did; and he said that, for lanthanum, ytterite earth might be used. His friend had throughout been endeavouring to confuse what the patentee had purposely separated. Unless the plaintiffs could succeed on the broad contention that the patent covered any kind of rare earth, they must show that the defendants used an equivalent for the lanthanum; and they could only do this by confusing the cerium and yttrium groups, and making them into one. He was confident that his Lordship would come to the conclusion that there was a broad distinction between the two, which was well recognized. It was quite evident, from the words of the specification, that the patentee had this distinction in his mind, because he gave one equivalent for one group and another for the material included in the other group. The process of applying the materials, it was now sought to set up as the essence of the invention; but it was evidently only a subsidiary point, and simply described a mode of utilizing the materials.

Mr. Justice WILLS said the difficulty in these cases was always to ascertain what was the substance and what was only an accident.

Mr. BOUSFIELD agreed. But if the method of using was essential, why was not every part—including the ammonia treatment—essential. The words "substantially as described" neither enlarged nor restricted the meaning of the other words. The substance must be what was stated in the patent to be of importance, not what learned gentlemen had found out afterwards, and said came within it. This was necessary for the protection of the public. The policy of the law was no doubt to protect an inventor; but it was not to enable him to prevent other inventors working in the same field. This was laid down in many cases. During the currency of the patent, it was of the utmost importance to the public to know—not how to work the invention (that came in afterwards) but how far they might safely go without infringing the patent.

Mr. Justice WILLS asked if a new substance called (say) "Bousfieldium" or "Moultonium" had been discovered, which produced the same effects as the rare earths here described and belonging to the same family, would the learned Counsel say that anybody was at liberty to use the process here described to that new substance.

Mr. BOUSFIELD: Yes.

Mr. TERRELL dissented.

Mr. BOUSFIELD said he should bring authorities in support of his view. It had often occurred in connection with patent medicines. He submitted that the same view was supported by Welsbach's own subsequent patents. The broadest construction his friend could contend for was that he had a patent for zirconium and lanthanum, with or without yttria; and for any equivalents for either of these substances. And he (Mr. Bousfield) should submit that could only include substances known at the date of the patent to be equivalents, without further experiment. He next proposed to deal with the question of the cerite and ytterite earths, as shown by well-known books. He should, however, first say that the defendants proposed to make mantles compounded of zirconium and erbium; and if by mistake they had obtained impure erbium, that ought not to affect the issue. They furnished the plaintiffs with articles made as they believed of zirconium and erbium, with a little magnesia; and later on they sent certain others, which had been examined by the plaintiffs. But these latter ones were not those mentioned in the particulars of breaches; and as to these no evidence had been given. Now erbia was well known in 1885; and if Welsbach intended to claim it, he could have done so, as he did in his next patent. The learned Counsel then read passages from Bloxam in 1853, Graham in 1858, Otto Graham, Dana (two editions), Frankland and Japp, and Crookes—at some length, to support the view that the cerium and yttrium groups were always recognized as being distinct. Watts's dictionary and Thorpe were also referred to, for the same purpose; and the volume of "Encyclopædia Britannica" which his Lordship had mentioned.

After the adjournment for luncheon,

Mr. BOUSFIELD referred to Dana's work—the last edition—as to the constitution of gadolinite, which he suggested was the natural mineral that would be understood as the source of ytterite earth. With regard to cerite earth, there was no such thing known in the market; and he suggested that the well-known mineral cerite must be what was intended. The essential compound described by the patentee consisted of zirconium and lanthanum; and as the defendants had not used one of the ingredients—lanthanum—nor any equivalent for it, there was no infringement. He then proceeded to deal with the law of the case. Mr. Justice Wright had, he said, interpreted the patent; and he should read his judgment as being useful, though he did not say the decision was binding on his Lordship. He first cited the case of *Dudgeon v. Thompson* (3 App. Cases, 34) in support of the proposition that, in the construction of a specification, and in determining what were equivalents, one must not go outside the language of the specification itself. That was a patent for a tube expander—a mechanical invention, but the principle was the same. Long passages were read from the judgments of Lord Cairns, Lord Hatherley, and Lord Blackburn, illustrating the principle contended for.

Mr. Justice WILLS said these general principles were excellent in themselves, but their enunciation in connection with one particular case was not of much assistance in dealing with another. He never himself received much help from what were called canons of construction.

Mr. BOUSFIELD remarked that his difficulty was that his learned friend's case, as opened, seemed to contravene all the fundamental principles of construction.

Mr. Justice WILLS said his experience was that so-called canons of construction were either misleading or useless to those who had much experience of the law. One had to take the particular document in question, and endeavour to find out what it meant.

Mr. BOUSFIELD thought canons might be useful in recalling well-known principles to mind in their application to a particular case. The plaintiffs were not only fighting the present case, but many others; and they wanted to enlarge the scope of their specification to the utmost possible limits. He next referred to a chemical case in the same volume, *Bailey v. Robertson*, where the question was whether the complete specification went beyond the provisional. In this case the provisional specified a compound of two things; and the complete, one of them only. It was here held to be bad. The next case was *Heath v. Unwin* (2 Webster's and 5 House of Lords), also a chemical case; showing that a patentee could only claim the use of equivalents known to be such at the date of the patent. It was now suggested that anyone at the date of this patent would know that anything which existed in the ytterite earths could be used alone as an equivalent for the combination specified, although at the very time the patentee warned the public against the use of two of them—didymium and cerium. Before referring to the last case he should cite on this point—*Nobel's Explosive Company v. Anderson*—he would read some dicta of Baron Alderson in an earlier case, which were commented on in the House of Lords in Nobel's case. It was now admitted that one of these dicta—as to patenting a process but not a principle—was stated in too general terms; and it was corrected by Baron Alderson himself in another case. Nobel's case was then referred to at considerable length, and passages from the judgments were read.

The further hearing of the case was then adjourned to Monday.

On the proceedings being resumed yesterday, Mr. Bousfield continued his address on behalf of the defendants; and afterwards Dr. Otto Hehner was examined and cross-examined at some length. Mr. J. H. Sheldrake, the Managing-Director of the defendant Company, then gave evidence; and the hearing was again adjourned. Our full report of the case will be continued next week.

Imitating the Clark Gas-Lantern.

In the Chancery Division of the High Court of Justice last Friday, Mr. Justice North had before him a motion for an injunction in the case of *Clark v. Sax and Co.*, to restrain Messrs. Julius Sax and Co. from infringing the design for gas-lanterns registered by the plaintiff. It may be remembered that, on the 8th ult. (*ante*, p. 344), a motion for rectification of the register was unsuccessfully made before his Lordship—thereby establishing the validity of the registered design; and on the same occasion, the Court refused a motion to restrain infringement by the defendants, as the lamp complained of did not infringe the registered design. After the termination of this litigation, the plaintiff's attention was called to the fact that the defendants had fixed in the Metropolitan Meat Market a new set of lamps, which it was alleged were an exact imitation of his. His Lordship held that the lamps complained of were a palpable infringement of the plaintiff's registered design; and he granted the injunction.

Injuries from a Gas Explosion—Use of Soap by Plumbers' Boys.

A small but interesting case was before his Honour Judge Shand at the Liverpool County Court last Thursday. It was an action brought by a widow named Clara P. Tucker, residing at 81, Walton Lane, Liverpool, against James Tweedley, a plumber and gas-fitter, for the recovery of £9 13s. 11d., damage done to her furniture and effects, and also for personal injury, by the alleged negligence of defendant's servant. Mr. H. F. Neale appeared for the plaintiff; but defendant was neither present nor represented. Plaintiff's case was that in January last she engaged defendant to do work in connection with the gas-fixtures of her house. A youth was sent on Jan. 21; and while engaged on the work, he asked her to supply him with some soap, as he had forgotten to bring any white lead. She questioned him as to soap being an effective substitute for white lead for the purpose; and he replied that it was frequently so used by gas-fitters. After he had finished the work, the gas was turned on at the meter; and a trial was made by lighting several jets. Some time after the youth had left, plaintiff went to light the lobby gas; and immediately she struck a match, a violent explosion occurred, which threw her on the stairs some distance away, where she lay unconscious for a time. When she recovered, the house was full of people; and large pieces of the ceiling and walls were scattered in all directions, and several pictures and ornaments were smashed. She had been under the doctor ever since, and had not yet fully recovered from the shock. After the explosion, it was discovered that a piece of rag had been used in one of the connections of a gas-pipe; and this, together with the use of the soap, was the negligence alleged against the defendant, which had caused the explosion. Defendant saw the damages the following day, and promised the plaintiff, she alleged, that he would make good the loss. His Honour, having heard evidence on the various items of claim, gave judgment for the full amount with costs.

Fraudulent Consumption of Gas at Reading.

At the Reading Borough Police Court, on Monday, the 9th inst., a summons was heard against Francis Henry Knights, of 60, South Street, Reading, for fraudulently abstracting and consuming gas belonging to the Reading Gas Company on the 25th ult. It is interesting to note that this is the first prosecution of the kind that has ever been instituted by the Company. Mr. A. H. Cane, the Secretary of the Company, said that in 1893 the defendant was one of their consumers. In June that year, however, his meter was removed for non-payment of arrears; and from that time to the present, there had been no meter in the house. On the 24th of February, it was ascertained that the defendant was consuming gas; and the following day the Company's inspector called at the house, and made an examination. He found that the cap which had been fixed at the end of the service-pipe when the meter was removed had been taken away, and a connection made, by means of india-rubber tubing, with the pipe supplying the house. A supply of gas for the house was obtained in this way; and the inspector saw it burning at the time he called. The circumstances of the case were laid before the Directors; and they decided to prosecute. At the same time, as they did not wish defendant to be unduly punished, proceedings were taken for the statutory offence now charged, instead of the more serious one of larceny, as in the latter case the defendant would have been liable to a term of imprisonment. Mr. Cane asked the Bench to deal leniently with the defendant, having, of course, regard to the seriousness of the offence. Defendant pleaded guilty. Mr. Creed, who appeared on his behalf, thanked the Company for the kindly consideration they had shown in the matter. In mitigation of the penalty, he bore testimony to the irreproachable character that defendant had hitherto borne; and he urged that the mere fact of appearing in that Court, and pleading guilty to such an offence as that with which he was charged, was in itself a heavy punishment. The Bench, in convicting the defendant, took into consideration the fact that Mr. Cane had asked for leniency; and they inflicted a penalty of £3 and costs, or one month's imprisonment.

A Gas Manager Slandered.

At the West Riding Winter Assizes last Tuesday at Leeds, before Mr. Justice Lawrance, a case was heard in which Mr. Pell, the Manager of the Gas-Works at Hemsworth, belonging to Messrs. Clayton, Son, and Co., Limited, sought to recover damages from Mr. Edward Clarke, a clothier of Hemsworth, for slander. Mr. T. R. D. Wright represented plaintiff; Mr. S. D. Waddy, Q.C., and Mr. J. A. Compston appeared for defendant. It was gathered from the evidence that on Oct. 14 last, defendant was annoyed with the quality of the gas, and wrote to Messrs. Clayton, Son, and Co., asking them to send someone to look into the matter, as the gas was "simply poisonous." On Oct. 28, Mr. J. J. Baines, Secretary to Messrs. Clayton, and the plaintiff called upon defendant to collect the amount of his account. According to the evidence given by plaintiff, defendant complained of the quality of the gas, and referred to a letter he had written to Messrs. Clayton. Plaintiff asked him why he had not written to him; and defendant replied, "Send a letter to a drunken scamp like you." He added that they would never have better gas till the plaintiff

spent more time at the works, and less time at the public-house. In cross-examination, plaintiff said he had been Manager of the works three years. About three months before Oct. 28, defendant had complained about the quality of the gas, and had then said to Mr. Baines, "Although their former Manager was drunken, their present one was no better." In re-examination, plaintiff said he was never drunk in his life. Mr. Baines gave corroborative evidence. He added that, when defendant complained about the gas, he told him the bad gas was caused through an accident; but they had taken steps to have it remedied, and hoped the same thing would not occur again. On Nov. 22 defendant saw the members of the firm in his presence. He informed them that Pell had entered an action against him; and he had come to see if it could not be stopped. Witness told him they had nothing whatever to do with the case. Defendant accused Pell of drunken habits, and asserted that one day he had been so drunk that he had to be taken home in a cart. The plaintiff was receiving 24s. per week; and, pending these proceedings, he had lost an advance of wages of about 6s. per week. Mr. J. R. Pickering, a member of the firm, also gave evidence as to the interview with defendant. John Jackson, who it was alleged had driven the plaintiff home drunk, stated that it was not true; but on one occasion, in July, he had remarked to his driver, that he thought Pell was a bit "fresh." Addressing the jury for the defence, Mr. Waddy submitted that there was no malice shown in this case, and that the words used by the defendant were privileged. Defendant was examined, and declared that he had seen plaintiff the worse for drink on several occasions. He had called plaintiff a drunken thing, but did not speak any other words with regard to drunkenness. The jury returned a verdict for plaintiff for £10.

Increased Storage at the Clayton Gas-Works. — Messrs. Clayton, Son, and Co., Limited, of Leeds, have been entrusted with the contract for the erection of the telescopic gasholder, 60 feet in diameter, at the Wilsden Station of the Clayton, Allerton, and Thornton Gas Company, for which tenders were recently invited in the "JOURNAL." The successful firm submitted the lowest offer.

San Paulo Gas Company, Limited.—At the meeting of this Company on the 25th inst., the Directors will report a balance of £12,759, including £2302 brought forward, available for division; and they will recommend a dividend of 4½ per cent. for the six months ending Dec. 31 last—making 8 per cent., free of income-tax, for the year 1895. This will absorb £11,250, and leave a balance of £1509 to be carried forward. The business of the Company continues to show a satisfactory increase both in the sale of gas and of residual products; and the works have been maintained in thoroughly good repair.

The Leakage of the New Reservoir at Redruth.—The hopes entertained last month that the cause of the serious leakage of the new reservoir at Redruth had been discovered, and that the measures taken to stop it would prove effectual, have not been justified. In order to test the reservoir, water was pumped into it in addition to the quantity which flowed in by gravitation. The result was to reveal the existence of a leak of some magnitude, though it was not so bad as that which was first reported. In the end, it was found that, in spite of the pumping, there was no perceptible increase in the depth of the water in the reservoir; and on the 6th inst. pumping was stopped. The matter came before the District Council yesterday week, when further consideration of the subject was relegated to a Committee consisting of the entire Council.

The Public Lighting Question at Wimbledon.—Reference is made in our "Electric Lighting Notes" to the latest phase of the electric lighting question at Wimbledon. The matter is "hung up" till October, when, according to present arrangements, a further move is to be made by the District Council. In the meantime, the opponents of the scheme will not lose, but rather gain, strength. The Council have already been petitioned to allow the Mitcham and Wimbledon Gas Company to put up, by way of experiment—as they are willing to do, at their own expense—a number of incandescent gas-lights; and the petition has been backed up by an influential deputation of ratepayers. But the Chairman (Mr. A. Holland) told these gentlemen that the Council objected to allowing the Company to do what they proposed. They knew all about incandescent gas lighting, and, apparently, did not think much of it. No; nothing but the electric light will do. But the Council have met with a check at head-quarters; and as this lighting business will be made a test question at the next election, there may be some lively meetings at Wimbledon.

Gas-Works Extensions at Keswick.—The Keswick Gas Company have been extending their plant to meet the growing requirements of their customers. On Friday, the 6th inst., Mr. Mumberson, the Chairman, had the pleasure of formally "opening" a new holder which had been erected, at a cost of about £1500, by the Whessoe Foundry Company, Limited, of Darlington. The holder is contained in a steel tank 60 feet diameter by 20 ft. 6 in. in depth. The holder is 58 feet diameter by 20 feet deep; and its capacity is 52,800 cubic feet. It has been constructed so that another lift may be added when necessity requires it. After having opened the valve of the holder in the presence of his colleagues, the Manager (Mr. T. Heywood), the Secretary (Mr. J. H. Brodie), and others, Mr. Mumberson said a few words regarding the progress of the Company, which in the year 1877, with a capital of £6000 and gas at 5s. 5d. per 1000 cubic feet, paid 6½ per cent. dividend. They were now able, notwithstanding the competition of the electric light, to pay 8 per cent. upon a capital of about £10,000 with gas at 3s. 3d. He hoped at no very distant date to see a further reduction in the price. He expressed to the representative of the Contractors (Mr. Clark) the satisfaction which the new holder gave to the Directors; and he trusted that it might not be long before the services of the Whessoe Company would be again required. In addition to the new holder, the Company have had built two new benches of retorts in settings of sixes, heated on the generator principle. Messrs. R. Dempster and Sons, of Elland, were the Contractors; the cost being about £380. Two new condensers have also been added; and sheds are being erected for the storage of coal and coke.

MISCELLANEOUS NEWS.

SHEFFIELD UNITED GASLIGHT COMPANY.

The Half-Yearly Meeting of this Company was held yesterday week—Sir FREDERICK MAPPIN, M.P., in the chair.

After the usual formal business,

The CHAIRMAN moved the adoption of the report (*ante*, p. 350). He said the half-year's working had been in every way satisfactory, and had realized a profit of £42,766. An important feature was that there had been an increased demand for gas for all purposes; £5950 more having been received for gas than in the corresponding half year of 1894. Tar had also produced £613 more. They had paid £1033 less for coal, and repairs of works had cost £1807 less than in the corresponding period of 1894. On all the residuals, with the exception of tar, they had received a considerably smaller amount. For coke the decrease was £2129; and for sulphate of ammonia, £4244. They paid more in stokers' wages by £710; for repairs of mains, more by £1786; for the renewing and refixing of meters, £560; and for rates and taxes, £861. In spite of these adverse items, they were left, as he had said, with a profit for the half year of £42,766; and after paying the dividend, they had a balance in hand of £7760. He thought he was right in saying they all had reason to be satisfied with the working of the half year. The reserve fund was at its maximum—£86,192. From all he could find out, their works were in good order; the Directors having spent money freely in having an up-to-date plant for the production of gas. During the past year, they had expended £45,675 in the repair and maintenance of the works. In 1894, they spent £44,806; so that no one could accuse them of being parsimonious in their management. In the Company's present position, the Board felt justified in lowering the price of gas 2d. per 1000 cubic feet to all classes of consumers; the reduction to take place after the reading of the meter indices at the end of the present month. After that time, the price would be 1s. 8d., 1s. 10d., and 2s. per 1000 cubic feet, according to consumption. Their expenditure on capital account had been small—£4850. They sold 74,277,000 cubic feet of gas more than in the corresponding period of 1894—being an increase of 7·89 per cent.—and yet, with this large demand upon them, they found no difficulty in keeping up the supply in every respect. The leakage had amounted to 60,541,000 feet, which was less by 2,000,000 feet than in the corresponding period of 1894, although they had sold so much more gas. The tests of the illuminating power during the half year numbered 1163—giving an average quality of 18·13 candles; and the tests during the twelve months had been 2313—showing an average quality of 18 candles. They could therefore claim to supply gas at the lowest price for the quality of any undertaking in the kingdom. The coal carbonized in the six months had been 5680 tons more than in 1894. As he had previously stated, they had received less for all kinds of residuals, with the exception of tar, for which they obtained £613 more. For sulphate of ammonia, their returns had been reduced to 1s. 4d. per ton of coal carbonized, as against 2s. 3¾d. in 1894. This was a reduction none of them could contemplate; but if producers of this article would speculate in it, and keep stocks which buyers easily obtained information about, they must not be surprised if the price was reduced in the market. Happily for the shareholders, the Board had at no time speculated in residuals. They had obtained the best price they could upon the market; and he thought the results showed they had acted in a wise and judicious manner. During the six months, they fixed 1455 additional meters. Of this number, 794 were 2-light; and the remainder varied from 3 lights up to 600 lights. During the twelve months, they sold 1163 gas-fires, and 611 boiling and grilling stoves; 42 additional cookers were let on hire, and 30 sold; and 58 additional gas-engines were fixed. This increase in the demand showed, he thought, that gas was being more used than at any time; and the Company, in his opinion, had every reason to anticipate that the demand, so far from decreasing, would increase in the future. The discovery of the Welsbach light was a great advantage to all gas companies, as it gave a light equal to from 50 to 60 candles, consuming only 3½ or 4 cubic feet of gas per hour, and costing less than half a farthing per hour. Surely everyone should be satisfied with such a result. Anyone living in a small room would find the smaller burner satisfactory—giving 30 candles as against 15 or 16 candles with the ordinary burner; and this, he thought, was in itself a guarantee for the safety of the property of the shareholders. The latest improvement, and a very valuable one, was the holophane globe, which was described as "the latest aid to the dissemination of light, be it gas or be it electricity. It redeems any injurious effects these brilliant lights may have on the eye, and yet it magnifies their power in every direction, and gives every ray of light to the utmost." He could quite endorse this statement. When he saw the globe himself, some two months ago, he was quite sure that the Welsbach light was increased many times in value by having such satisfactory assistance as it obtained from the holophane globe. He thought the shareholders might be satisfied of the assured success of their Company, remembering the small capital that was employed per 1000 cubic of gas sold compared with that of other companies. Plymouth was the lowest, Portsea was the second, and Sheffield came third out of twenty of the largest gas undertakings, both private and municipal, from which they had returns. He was pleased on seeing an account of two papers which were read at the meeting of the Yorkshire section of the Society of Chemical Industry—one by Dr. J. B. Cohen, of the Yorkshire College, and the other by Mr. G. H. Russell. These gentlemen had been testing gas-fires and coal-fires. They found that, with an open chimney, a coal-fire produced a greater draught; but with a gas-fire there was less draught, and the temperature was raised higher and more quickly. His own experience was that, with a properly-constructed gas-fire, they could get a room heated in half or quarter the time they could with a coal-fire. These two gentlemen gave one very satisfactory piece of advice when they warned people never to use gas-fires for heating ordinary rooms unless the room had a chimney in it. Some people ventured to disregard this caution, and in that they made a great mistake. They had heard much latterly of depression of agriculture. Twenty-five years ago a gentle-

man, Mr. Duncan, tried the experiment of a sugar refinery in Suffolk, for making beetroot sugar. His scheme failed, because the farmers would not grow sufficient beetroot to supply the manufactory. Why was that? Because at that time they were receiving 50s. or 60s. per quarter for wheat; and they thought that a better occupation than growing beetroot. Now wheat was 24s., or less. It did not pay to grow beetroot at that time at £1 per ton; the acre producing 15 tons, and the cost of growing and delivering it per acre being £9 5s. The present price of beet was 17s. per ton; and 15 tons per acre would realize for them £12 15s. Therefore, if they took the cost from what they would obtain for it, they found the farmer's profit would be 25½ per cent. Surely those interested in land and agriculture should make some forward step to remedy the evils of which they complained. Let them depend upon themselves more, and not complain without making some effort. If they went in for the production of beetroot, the demand for sulphate of ammonia in this country would be greatly increased. At the present time, the great bulk of it went to France, Germany, Holland, and the United States. In these countries, the farmers knew the value of it for growing beet and other things; while here farmers and landowners paid little or no attention to it. It was surely time that more energy was shown by this class of the community. Although he had been talking brightly of the prospects of the Company, they must not deceive themselves. Let them bear in mind they had the electric light with them, and that it was going to stay, and was going to increase as gas had done, though possibly not to the same extent; but he believed the electric light would gradually cost less than it did at the present time. Knowing this, he yet felt the same confidence as of old in the undertaking in which he and they were interested, because the discoveries in acetylene and the great strides made by the engineers and those interested in gas, showed that gas was as much in its infancy now as the generation of electricity. For some years, electricity had been with them. It was quite unable to stop the increasing demand for gas; and their engineers and others had only to exert themselves (and now that they had an opponent, he believed they would do so, for they had some pride in them) for the industry in which they were so much interested to be as successful in the future as it had been in the past. In conclusion, Sir Frederick advised household consumers to be at some little expense and trouble in supplying themselves with new and economical burners; and they might, he said, depend upon it they would never have cause to regret it.

Mr. R. A. HADFIELD seconded the resolution, which was adopted.

On the motion of the CHAIRMAN, seconded by Sir HENRY STEPHENSON, the usual dividend of 10 per cent. was declared.

Mr. JOHN WILSON congratulated the Directors upon their action in reducing the price of gas, and advised them to abolish meter-rents as soon as possible.

The CHAIRMAN, in reply, said he would not make any promise which the Directors were not likely to fulfil; but if the Company continued to succeed so satisfactorily, the abolition of meter-rents might come in the near future.

A vote of thanks to Sir Frederick Mappin for presiding terminated the proceedings.

HASTINGS AND ST. LEONARDS GAS COMPANY.

An Extraordinary General Meeting of the above-named Company was held on the 5th inst.—Mr. J. A. THORPE, J.P., in the chair.

The SECRETARY (Mr. A. E. Young) having read the notice convening the meeting, the report of the Directors, which was summarized in the "JOURNAL" for the 3rd inst., was taken as read.

The CHAIRMAN expressed great pleasure at meeting the shareholders, as, owing to his health, he thought he should not be able to attend. But he would ask the Deputy-Chairman (Dr. Gray) to move the adoption of the report.

Dr. GRAY, in complying with the Chairman's request, said he would first ask the shareholders to compare the quantity of gas sold during the past half year with that consumed during the corresponding period of 1894. They would notice there was an increase of nearly 7½ million cubic feet; and if they compared the whole year with the preceding one, they would find the increase was rather more than 17½ millions. This, he believed, they would all agree, thoroughly justified the Directors in stating in their report that the growth of the Company's business had been maintained. The report also dealt with the reduction in the charge for gas—the price during the past year having been 3s. 2d. per 1000 cubic feet, as compared with 3s. 4d for the preceding year. It was important that they should pay strict attention to this, because it accounted for what otherwise would appear to be an anomaly in the report—viz., that while the increase in the gas consumed was some 17½ millions, the increase in the receipts was only £44. But they must bear in mind the reduction of 2d. per 1000 cubic feet, which was equivalent to a loss of £2855; so that the real increase, if they had not made this reduction, would have been £2900. During the present year, the Directors had still further reduced the price to 3s. per 1000 cubic feet. He should like to remind the public generally that, owing to the heavy coal duty they had to pay at Hastings, the price of 3s. was really equivalent to 2s. 9d. Having regard to the coal duties, the distance from the collieries, and the absence of a port, he could with confidence say that there was no company similarly situated to theirs that could show a better result than they did. There could be no doubt that, as stated in the report, through the mild weather, and depression in the market for residuals, the returns had been considerably affected. But they had only had the same experience as most other gas companies. Their No. 3 gasholder had been satisfactorily completed, and put to work, though in many respects it was a somewhat novel experiment. It had, however, answered exceedingly well. Speaking on the increase in the use of incandescent gas-burners, Dr. Gray said that, for economy and efficiency, and from a sanitary standpoint, no better light than this could be obtained. The demand for automatic meters and stoves also continued; and they had now 563 automatic meters in use. He moved the adoption of the report.

Mr. G. W. VENESS seconded the motion, and inquired how many stoves the Company had out on hire.

Dr. GRAY said they had 2465.

Mr. T. J. WALDER said he was extremely gratified with the satisfactory report. With regard to the incandescent light, he did not think Dr. Gray had praised it enough. There could be no doubt that it was the coming light; and people were beginning to know it. He thought the Corporation should have the whole of the streets lighted with it. Although no doubt the cost might be considerable, he thought the Directors might see their way to enter into some contract with the Corporation to instal the new light. As it was, it ran the electric light very close; and when it came to cost, that light was out of the field altogether. It would prove a saving to the ratepayers, and a profit to the Company; and he advocated it very strongly.

The report was adopted; and dividends at the rates of 12½ and 9½ per cent. per annum were declared.

A vote of thanks having been accorded to the Chairman, he briefly responded, and the meeting terminated.

DOVER GAS COMPANY.

The Public Lighting by Incandescent Gas-Burners.

In the "JOURNAL" for the 25th ult., we noticed, under the heading of "Provincial Gas and Water Companies," the report of the above-named Company for the half year ending Dec. 31 last. In moving its adoption at the recent meeting of shareholders, the Chairman (Mr. Willsher Mannering) remarked that perhaps the most gratifying circumstance of the period covered by the report had been the increased sale of gas, notwithstanding the competition of the electric light and the decrease in consumption which had followed upon the extended use of incandescent gas-burners. The quantity of gas supplied to private consumers was 4 per cent. more than that in the corresponding period of 1894; but a decrease of 13 per cent. in the public lighting brought down the net increase to 1·66 per cent. It was also satisfactory to find that there were 49 more customers on the books, 62 more meters fixed, and 106 additional gas-stoves on hire than there were a year ago. The total number of stoves hired at the end of 1895 was 804. The revenue, as compared with the corresponding half of 1894, showed an increased gas-rental of £216, and a rise of £61 in meter and stove rentals. On the other hand, residuals showed a drop of £230. The drawback was due to the falling off of £275 in the receipts for sulphate of ammonia. With regard to expenditure, their coals had been obtained on the more favourable terms of 9d. per ton less than before; so that though 196 tons more were used, there was a saving of £154. The working charges, including rates, &c., were also, in the aggregate, less by £176. These advantages were, however, more than counterbalanced by an increase of £654 for maintenance, mainly owing to the replacement of the steam-boilers, which had become necessary. But for this special charge and the loss of revenue from sulphate, the profit for the half year would have been largely in excess of the amount required for dividend. Instead, it was insufficient by £239. The balance stood in the accounts as £3137; and the half-year's profit was £2443—making a total of £5580 available for division. After the dividend was paid, there would remain £2898 to be carried forward; so that the financial position of the Company was in no way affected. As regards manufacture, the Directors could still show excellent results. During the half year, 8677 tons of coal had been carbonized; producing 95,794,000 cubic feet of gas, or equal to 11,040 cubic feet per ton. The quantity of gas sold and used was 89,152,400 cubic feet, or 10,274 cubic feet per ton; the unaccounted-for gas being 6·93 per cent. Another progressive step had lately been taken; as the Directors had entered into a contract with the Corporation for the lighting of the remaining public lamps with incandescent gas-burners. They would not obtain any financial benefit from the change; but the Company's position would be strengthened. It afforded the Directors much satisfaction to be able, through the new system, to greatly improve the lighting of the streets—the light given by the incandescent burners being about three times that of the old burners—and to do so at a slightly reduced charge. The Chairman concluded by reminding the shareholders that the Company were greatly indebted to the officers and the able body of workmen for the very flourishing condition of the concern; and he took this opportunity of thanking them for their continued efficient services. Mr. Burchfield suggested that the Directors should consider the advisability of introducing automatic prepayment meters, which, he said, would be useful to the working classes. The Chairman said the Directors had given careful attention to the matter; and probably they might introduce the system in a short time. The report was adopted, and a dividend at the rate of 7½ per cent. per annum (less income-tax) declared. Mr. H. W. Thorpe, in moving a vote of thanks to the Chairman and Directors, said the Board had, in their public spirit, thought proper to give the town an improved gas-burner at a cheaper rate than that which had been paid in former years. Those who had seen the light were bound to say, without prejudice, whether they were in favour of electricity or gas, that it was a perfect, reliable, and cheap one. They had only to look at the entrance to the Promenade Pier, and there they would see four splendid lights which only cost £15—half the expense of one arc lamp; and it would not require any great scholarship to compare the cost of that with the electric light, and say what the result would be. The proposition was carried unanimously; and the Chairman briefly acknowledged the compliment. The proceedings closed with a vote of thanks to the Manager (Mr. R. Herring) and the staff.

Gas v. Electric Lighting at Kingston-on-Thames.—The Chairman of the Kingston-on-Thames Gas Company (Mr. P. Jones) told the shareholders at the recent half-yearly meeting that, in spite of the competition of the electric light, the earnings during the second half of last year were ample to pay the usual dividend of 10 per cent. on £85,000 of the share capital, and 7½ per cent. upon the £15,000 additional capital. With regard to the works, which are under the supervision of Mr. H. F. Packham, the Company's Manager, they have been brought into excellent condition; and an officer of the Board of Trade who has lately visited them found everything satisfactory.

THE LONDON COUNTY COUNCIL AND THE SOUTH METROPOLITAN GAS BILL.

At the Meeting of the London County Council on Tuesday last, the formal consent of the Council was asked, under the Borough Funds Act, to the opposition of certain Bills now before Parliament; one of them being the South Metropolitan Gas Bill. It may be remembered that, at the meeting of the Council on the 25th ult., a recommendation of the Parliamentary Committee that a petition should be presented against the Bill was adopted. The Chairman of the Committee (Mr. T. M'Kinnon Wood) moved the necessary resolution; but it was opposed by Sir Blundell Maple, who expressed the hope that the proposed action would not be taken. He said the Bill seemed to him to be one of the best that could be brought forward in the interest of both consumers and workmen. Small capitalists would be able to invest their money in stocks paying 4 or 5 per cent., which would be better than putting it into savings banks. The Gas Company had done their best to introduce workmen-directors; and they proposed now that the consumers should also be afforded a chance of having places on the directorate. He looked forward to the passing of the Bill with great interest; and he moved, as an amendment, that it should not be opposed. Mr. S. Webb argued that the Bill proposed to carry out an arrangement by which stock could be issued otherwise than by auction; thus doing away with the valuable principle of the auction clauses, and reverting to the old state of things. It would be interesting to see if any member of the Council could be found to vote for such a thing. Mr. Costelloe said Mr. Livesey, the Chairman of the Company, had admitted to the Parliamentary Committee of the Council that the result of the conversion of the stock would be to increase its value by something like £100,000. This was, no doubt, laudable from the Company's standpoint; but the Council, as trustees of the public money, took another view of the matter. Mr. Wood said he thought the House of Commons Committee last year expressed very clearly their opinion that no company should be permitted, by a Private Act, to obtain powers similar to those now sought by the South Metropolitan Gas Company. On a division, the voting on the motion was 55 for, and 51 against it; but as this did not represent an absolute majority of the Council, it was lost.

THE GAS AND ELECTRICITY SUPPLIES OF BRADFORD.

An Interesting Record of Progress.

At the Meeting of the Bradford Town Council yesterday week—the Mayor (Alderman W. W. Wood) presiding—Mr. W. C. Dixon, the Chairman of the Gas and Electricity Committee, made a statement as to the progress of the two departments and the results of the working during last year.

The minutes presented by the Committee included resolutions accepting a tender of Messrs. Brown and Co., Limited, to supply and fix two steam-boilers at the new electricity works at Valley Road, for £3000, and a tender of Messrs. Holdsworth and Sons to supply a steam boiler at the Mill Street gas-works, for £286; a resolution instructing the Electrical Engineer to proceed with the necessary alterations at the Bolton Road station, for the purpose of adapting the works to the increased electrical pressure occasioned by the change from the two-wire to the three-wire system; and resolutions recommending the Council to authorize the Committee to proceed with the letting of the contracts for the new electricity works, and to extend the area of the Corporation's electrical supply.

The adoption of the minutes was moved by Mr. Dixon, and seconded by Mr. T. Speight.

Mr. Dixon then said he believed the Committee were satisfied that everything connected with both departments was in working order. From other gas-works, they heard a good deal of complaint as to grievances among the men; but in Bradford they were fortunate in that the men seemed to think that, when they had grievances, the Committee and the Corporation met them in a fair and impartial manner. There had been a general expression of opinion at one time that gas would be displaced by electricity; and he had little doubt something of this kind would occur in the long run. But at present there seemed to be no movement of the sort. In 1895, there had been an increased consumption of gas. For that year the record of the quantity of gas made was 1,675,500,000 cubic feet, as against 1,548,066,000 feet in 1894; showing an increase of 127,434,000 feet. All this extensive manufacture was carried on with the small leakage of 3·97 per cent., as against a leakage of 4·72 per cent. in 1894. After paying interest and sinking fund, and lighting all the streets of the town at a cost of £11,394, there was still left for the half year ending in December, a profit of £10,472. He thought the existence of so large a profit on a capital outlay of £618,615 was very satisfactory. One of the most difficult problems the Committee had had to deal with was the downward tendency of the value of coke. The profits of the department would have been larger by £3000 or £4000 if coke had been saleable at the same price as in 1894. In that year coke was sold at 10s. and 7s. 6d. a ton for the respective qualities; whereas the prices obtained were now down to about 6s. 8d. and 3s. 4d. This decrease in value was equivalent to a loss of £4428. As against the decrease in the value of coke, however, must be taken a reduction of the price of coal, which amounted to about 6d. per ton in comparison with 1894. Nevertheless, he thought they ought to do what they could to make the best price for coke, whether it was sent abroad or delivered at home. The Council might be interested in a *résumé* of the progress of the gas-works. In 1827, the Corporation made 6 million cubic feet of gas; in 1837, 14 million feet, an increase of 133 per cent.; in 1847, 35 million feet, an increase of 150 per cent.; in 1857, 166 million feet, an increase of 374 per cent.; in 1867, 373 million feet, an increase of 127 per cent.; in 1877, 806 million feet, an increase of 116 per cent.; in 1887, 1288 million feet, an increase of 60 per cent.; and in 1895, 1675 million feet, an increase of 30 per cent. It appeared, therefore, that the consumption of gas was still holding its own, though he must admit that the electric light was now running a close race with it. The next department of the business was the chemical works; and, as the members knew, these were undergoing very extensive alterations. The decrease in the price of chemicals, especially in that of the principal article which the Corporation manufactured, had so seriously affected the profits of the department that a Sub-Committee had been appointed by the Gas Committee to overhaul the whole system; and he had every confidence in expressing the hope that what was being done would have the effect of to some extent restoring the profit that was formerly made from this branch. The Committee had already taken active measures for the improvement of the works. A new boiler had been put in in substitution for an old one; and they were replacing two horizontal lime stills for driving off the ammonia by one vertical still, which worked automatically. The new operations, it was believed, would have such results that no one need complain of them. As it was, there was a profit of £980 for the half year; this being 12·64 per cent. on the outlay. When they took into account that the decrease in the value of sulphate of ammonia was £5 1s. 5½d. per ton—being the difference between £8 14s. 1½d. per ton realized in 1895 and £13 6s. 7d. per ton in 1894—they would see how great was the necessity for a change in the process of manufacture. As to the electricity department, he had to report that it was progressing most satisfactorily, and was, he believed, exceeding in its results even the anticipations of its founder. The Committee had made various additions to the plant. The establishment of the three-wire system was also rapidly approaching completion; and the greater part of the borough, if not all of it, would soon be put upon the 230-volt basis. This would add to the revenue of the department, mainly from the fact that there would be less leakage from the high-pressure than from the low-pressure system. During 1895 the Committee had sold 373,372 units of electricity, as against 307,977 units in 1894; the increase being 65,395 units, and the demand a growing one. The Committee had at the present station a total indicated horse power of 2210; and this was very often taxed to its utmost capacity. There was a profit upon this department, after paying interest and sinking fund, and allowing for depreciation, of £1793, as against £919.

Mr. Minty asked if the Committee could not see their way to extend their street lighting operations to the slums. He had noticed that all the new experiments were tried in the main thoroughfares, where there was plenty of light.

Mr. Hindley complained of the poor quality of the gas which had been supplied lately.

Mr. O'Flynn asked if the cost of the buildings referred to in the Committee's minutes was included in the amount of £31,000 which had been sanctioned by the Council in relation to the Valley Road electrical works on a former occasion.

Mr. Speight supported Mr. Dixon's remarks as to the attention which the Committee had given to their work.

Mr. Dixon said his reply to Mr. Minty was that, if there were any dark slums for which he wanted lamps, he would, upon mentioning the matter, have the willing support of Mr. Speight and himself. His experience had frequently been that he had visited places with the object of granting lamps; and the people had said that there was plenty of light already. As to Mr. Hindley's complaint, the quality of the gas was at present about up to the average. The illuminating power during the previous week was 17·77 candles. In answer to Mr. O'Flynn, he had to say that the money necessary for building was included in the £31,000.

The minutes were adopted.

GAS AND METER CHARGES AT HALIFAX.

At their last Meeting, the Halifax Town Council considered a recommendation of the Gas Committee that the price of gas supplied outside the borough be reduced from 3s. 2d. to 3s. per 1000 cubic feet, with the present scale of discounts; the price in the borough to remain at 2s. 2d.

Mr. Hey moved, as an amendment, that the price of gas in the borough be reduced to 2s., with the present scale of discounts. He said he found there had been a profit on the gas-works during the year of £9000, £4000 of which it was proposed to devote to a depreciation fund, and £5000 to the relief of the rates. He moved the amendment because he believed strictly in direct taxation; and when so much profit was made and devoted to other purposes, the principle was seriously interfered with. It was stated that, if a reduction of 2d. were made, it would necessitate an addition to the rates. It might be so; but if anyone suffered loss through that, someone would also suffer by the present arrangement. He maintained, however, that those who used gas were entitled to the profits, if there were any. It was one of the first principles of municipalization that the Corporation should exist for the benefit of the ratepayers; and he thought they would be doing exactly right by reducing the price of gas to those within the borough equally as they were reducing it to those outside.

Mr. Crossland seconded the amendment, which was supported and opposed by various members.

Alderman Woodhead stated that the Gas Committee had had a fortunate year, and had a handsome surplus of £9222, £5000 of which they willingly devoted to the borough fund, leaving £4222, which they asked the Council to give to the Committee. As to the proposed reduction in price, it would mean considerably over £5000; and as they only estimated to make a profit during the coming year of £4090, this would be swept away at once. The Committee could not use any part of the profits except for repairs; and a good many portions of the gas-works required repairing. It was well-known that the "old end" was now working very uneconomically, and cost 2s. per ton more for carbonizing the coal than the other end. In fact, with new plant, he had no hesitation in saying, they would save 2s. 6d. per ton of coal. He did not think anyone would object to hand over a portion of the profits when they had such a large sum at their disposal; at the same time, during the last five years, the profits had not averaged more than £4000 a year, and he did not see that they could base their calculation upon anything else. In addition, however, to the estimated profit of £4090, they proposed to give relief to the consumers outside

the borough, which would make a difference of £400, and to reduce the meter-rents to the extent of 50 per cent., which would represent £1300. It was thus absolutely impossible for them to reduce the price of gas 2d. within the borough.

The amendment was lost by a considerable majority; and the minutes were then adopted.

SMETHWICK CORPORATION GAS SUPPLY.

Reduction in the Price of Gas.

At the Meeting of the Smethwick District Council last Tuesday, the Gas Committee presented their annual report, together with the statement of accounts of the gas undertaking for the past year, some particulars from which were given in the "JOURNAL" last week. A profit of £2595 was shown; and the Committee recommended that the price of gas should be reduced, as from the date of the quarterly reading of meters at Lady Day, as follows: For quantities under 25,000 cubic feet per quarter, 2s. 9d. per 1000 cubic feet; under 50,000 cubic feet, 2s. 7d.; above this quantity, 2s. 4d. Mr. J. Stones, in moving the adoption of the report, remarked that, as far as the Committee could see, they would during the present year make the same profit on the gas undertaking as that now shown; and consequently they had considered what to do with the money. They had received complaints from the consumers that the charge for gas was very high at Smethwick, as compared with the surrounding districts. No doubt this was the case. But he reminded the Council that at Smethwick their position was quite different from other places. Two firms in the Smethwick district—viz., Tangyes Limited and Messrs. Nettlefold—used more gas than the whole of the small consumers put together. The average price now charged in the district was 2s. 7d. per 1000 cubic feet, as compared with 2s. 8d. at Oldbury, 2s. 6½d. at West Bromwich, and 2s. 4d. in Birmingham. If the recommendation of the Committee were adopted, their average price would then be 2s. 5d. Mr. Howell asked what difference the reduction would make upon the year's trading. Mr. J. Brookes said they anticipated that at the end of the present year the net profit would amount to £1470. Mr. Stones said the Committee considered that next year they would be able to hand over £1200 towards the relief of the rates. The report was adopted.

OLDBURY GAS SUPPLY.

The annual report and accounts for the year ended Dec. 31 last in connection with the Gas Department of the Oldbury District Council have lately been issued by Mr. A. Cooke, the Manager and Secretary. The total amount borrowed to the end of 1895 was £79,199, of which £8960 has been repaid; leaving the outstanding loans £70,239. The sale of gas realized £9744; the residual products yielded £2798; and the income from the gas-fittings account amounted to £185—the total receipts amounting to £12,757. On the expenditure side are the following items: Manufacture of gas, £8041 (including £2055 for the renewal of the retort-bench in connection with regenerative furnaces); distribution, £323; public lamps, £297; rents, rates, and taxes, £791; and management, £275. The total expenditure was £9728; leaving £3029 as the gross profit on the year's business. A memorandum is attached to this account by the Manager, as follows: "Gross profits as shown, £3029; new retort-bench, £2055; reduction in the price of gas, £550; increase in rates, £163—total, £5797, as compared with £5493 last year, or an increase of £303, excluding a reduction to the amount of £487 in residuals." According to the profit and loss account, the interest on mortgages accrued to Dec. 31, 1895, amounted to £2561; and the instalments for the repayment of loans to £1101. The amount transferred to the general district rate account is £400; making a total of £4062. The balance brought down is £922; and the amount carried forward is £4964, as compared with a balance of £5887 brought from the last account. The quantity of gas made was 75,578,000 cubic feet, of which 72,442,000 cubic feet were sold and 867,000 cubic feet used on the works; leaving 2,269,000 cubic feet, or 3 per cent., unaccounted for. The quantity of coal and cannel carbonized was 6686 tons; and the gas production was at the rate of 11,312 cubic feet per ton (21 cwt.). The following are particulars as to the residual products: Coke, 4251 tons 14 cwt. 2 qrs., or 12 cwt. 3 qrs. per ton of coal; breeze, 78 tons 11 cwt. 1 qr., or 1 qr. per ton; tar, 95,752 gallons, or 14·32 gallons per ton; ammoniacal liquor (11 oz.), 189,216 gallons, or 28·25 gallons per ton.

The report and accounts were presented by the Gas Committee at the last meeting of the District Council. They expressed their entire satisfaction with the Manager in conducting the works and the erection of the new regenerative furnaces during the past twelve months. Mr. J. W. Wilson, M.P., in moving the adoption of the report, pointed out that there was an increase in the sales of gas of 4,439,000 cubic feet, which was very substantial; and he congratulated the Council upon it. This increase was far larger than any of the members of the Gas Committee expected twelve months ago; and it compared favourably with other works in the neighbourhood. The immediate result of the additional quantity of gas sold, notwithstanding the reduction in price which was agreed to last year, and which he estimated would represent a loss of £600, was that they had actually received a few more pounds in 1895 than in 1894. This was very satisfactory; but it was still more so for the Council to know that the increased quantity of gas had cost them no more to manufacture than it did in 1894. This was a matter distinctly for congratulation. There had been a considerable falling off in the price of residuals. At the commencement of the year, the Committee estimated that the loss upon the products would be £500; and the actual amount was £496, which was a very near guess. An increase in the rates had caused a loss of £162 on the undertaking. The regenerative system cost £1900; and the Committee proposed to pay a portion of it out of the profits for 1894 and another portion during 1895. Owing, however, to the system of making up the accounts, the whole of the amount would have to be included in the past year's statement. Therefore what should have been a profit on the undertaking became a loss of £922. They could not, however, look upon this as an actual loss, in consequence of the special expenses the Committee had faced during the year. They had paid a sum of £400 in connection with the erection of the regenerative plant; and he considered that, on the whole, they had great cause to congratulate themselves on the trading of the year. The actual fall in the price of gas had been covered by the increased sale. They had now a profit representing 6¼ per cent. upon a trading concern, and, in addition, they had put by £8960 towards the repayment of capital and interest. With the payments the Committee had to face in the future, they could not see their way to making any contribution towards the relief of the rates. Mr. Davis seconded the motion. After a short discussion, the report was approved.

ELECTRIC LIGHTING NOTES.

The electric lighting scheme for Wimbledon has come to a deadlock. At the meeting of the District Council on the 4th inst., a letter was read from the Local Government Board, refusing to sanction the borrowing of money to carry out the scheme, until the Council had obtained from the Board of Trade a renewal of their Licence, and then only for the period over which the renewed Licence would extend. Mr. Crickmay inquired how the difficulty as to the Licence came to be overlooked so long. He remarked that it was impossible to get a Provisional Order for a couple of years. The Clerk (Mr. W. H. Whitfield) said the fact that the Local Government Board did not ask about the matter prior to fixing the date of the local inquiry led him to think that all was in order, and that they had only to hear the scheme upon its merits. There must have been some oversight in the Local Government Board office. Mr. Crickmay expressed surprise that the Council did not know these steps were necessary. The Clerk said he was unaware of the Board's regulation. The Chairman (Mr. A. Holland, J.P.) was passing on to the next business, when Mr. Clarke checked him with a pertinent question. He asked: "Is the electric lighting scheme to drop in silence." The Chairman replied that the only thing seemed to be to wait till next November to apply for an Order. The Local Government Board said: "Get your extended Licence, and we will grant the loan, to be repaid in the extended period." This red-tapeism between the two Boards was, he added, much to be regretted. Mr. Crickmay did not see eye to eye with the Chairman on this point. He said they could not take much objection to a certain amount of red-tape when they were going in for a loan of £32,000. If they applied for a Licence, why wait till October? Then arose the question as to what guarantee the Local Government Board would require for the repayment of the £32,000 in the event of an Order being refused. The Chairman said he thought they should apply for an extended Licence forthwith, with the view of preventing a company from invading the district. At this point a private consultation took place between the Clerk and the Chairman; whereupon the latter informed the Council that Mr. Whitfield did not attach much importance to the fear of a company invading Wimbledon. Mr. Neller remarked that a company would have to get a Licence themselves. He said his opinion was that, having done all they possibly could to get this loan, they must perforce wait until they could secure a Provisional Order; and he thought they would unfortunately have to wait fifteen months before they could go forward. The Council seemed perplexed by the circumstances; and it was tacitly understood that no further steps would be taken till October, when the present Licence will expire. And so the electric light for Wimbledon becomes, as the electricians are very fond of calling it, the "light of the future"—certainly not of the present. In the meantime, the Gas Company are at hand, and willing to assist in improving the lighting of the district. But their services are not sought. It is no doubt thought, by those who are so anxious to have the electric light, that, if once the Company were allowed to show the ratepayers what they can do with improved gas lighting in the public lamps, the chances of an electric lighting scheme being carried out would be more remote than ever.

The question of the charges for electricity has been the subject of much discussion at Hanley of late. The General Purposes Committee looked with favour upon the Brighton system; and, on their advice, it was decided by the Council as recently as January last that it should be adopted. But, notwithstanding numerous explanations, there were soon unmistakable signs that the system was not acceptable to the consumers. The Committee therefore thought it wise to reconsider the matter; and, at the last meeting of the Council, they introduced proposals to rescind the former resolution, and to charge general consumers 5d. per unit, places of worship 4d., and users of electricity for motive power 3d.—all subject to an abatement of ½d. per unit if the accounts were paid within 21 days from the quarter's end. The majority of the Council questioned the wisdom of the latter recommendation; and, after discussing the matter, they resolved to fix the price at 5d., with 5 per cent. remission for payment within 21 days. This makes the price 1d. less than last year.

The Halifax Town Council have given their consent to an application to the Local Government Board for sanction to the borrowing of £20,000 for electric lighting purposes. The whole amount is required for new plant and extensions of mains; and it is expected that it will carry the department over the next five years. About £3000 of the money has already been expended, notwithstanding a promise made by the Council to the Local Government Board some twelve months ago that they would never spend money until they had borrowed it.

When will the ghost of the St. Pancras explosions cease to haunt the worthy vestrymen of this parish? At their meeting last Wednesday, the subject again came up in a peculiar way, inasmuch as these representatives of the ratepayers imagined that they had met all their liabilities respecting the unfortunate occurrence by the payment, in September last, of £567 in favour of Messrs. Reid Bros., the Contractors, for ventilating the manholes, culverts, &c. Judge, therefore, of the effect produced at the Vestry by this paragraph of the Finance Committee's report: "Your Committee have received a second certificate, forwarded by the Electricity Committee, in favour of

Messrs. Reid Bros. for works in connection with the ventilation of manholes, culverts, &c., amounting to £358 11s. 6d.—such sum being in full discharge of all claims; and with this an account in favour of Professor Robinson, amounting to £14 6s. 6d., for commission on the foregoing certificate." The report farther on pointed out that the former payment of £567 to the same firm for this work was described by Professor Robinson as "the first and *final* certificate." The Finance Committee endeavoured to explain matters by putting in two letters from Professor Robinson, stating (1) that the first certificate was called "final" "owing to a misunderstanding of a communication from Mr. Snell;" and (2) giving certain details as to the schedule of rate. The Committee on these facts asked the Vestry for instructions. Dr. Bell, the Chairman of the Committee, submitted that, during his seventeen years' service on the Vestry, he had never heard such an unsatisfactory statement. Professor Robinson had certified the first payment presumably because he had thought it a fair price to be charged for the work; but, besides this new bill, he (Dr. Bell) understood that, before finality is reached, another £150 will have to be spent. Mr. Sweet, the Chairman of the Electricity Committee, pathetically explained that the Board of Trade were "rather hard on the Vestry at the time of the explosions;" and hasty orders had to be given to their Consulting Engineer, who estimated the cost of the work at £700 to £1000. If, therefore, that gentleman had given proper attention to his duties, he would not have endorsed the first certificate for the work as "final." Under the circumstances, however, he (Mr. Sweet) thought the Vestry had better pay, and settle the matter, though Professor Robinson's mistake was much to be regretted. Mr. Menzies defended the Electric Lighting Committee, and blamed the Professor; while Mr. Purchase asked why the Vestry should pay that gentleman commission on work which was not properly done, as they had since had to drain the culverts themselves. He also wished to know whether the original estimate was not £600, and whether the total cost was not £1300? Mr. Cox argued that the work had been negligently done—the Vestry's own employees having had already to alter 63 ventilators; and their Engineer had not come to the end of them yet. He (Mr. Cox) protested against commission being paid for supervision when no supervision had been exercised. Mr. Dixon agreed; and he moved, as an amendment, that the whole matter be referred back to the Committee. Mr. Hodgson, who seconded the amendment, suggested that the work was altogether badly designed. The amendment was eventually carried; so these two little cheques must wait, and the explosion ghost is laid for a while.

At a later stage of the proceedings, the Vestry agreed, after a long discussion, to divide the electricity account from the rate account, and decided that the former department should open a separate banking account on Lady-day next; the Manager of the bank being thereby appointed "Treasurer of the electricity portion of the account of the Vestry." This desirable reform met with much favour; and it is understood that a suggestion by Mr. Hodgson to subdivide the account into "capital" and "revenue" will be considered. Dr. Bell, it may be added, in explaining the scheme, said the Electricity Department was likely to be a borrowing body for many a long year, as any balance in hand at the end of each half year "would be drawn upon in relief of the current rates." Why did some of his hearers laugh ironically at this? Perhaps it was because the next recommendation of the Committee was to invite tenders for three new engines with dynamos, &c., at an estimated cost of £6300. This was agreed to.

A petition is being numerously signed in Colchester against the decision of the Town Council to undertake the supply of electric light, on the ground of the probable burden such a scheme will entail on the ratepayers. The War Department, at whose initiative, it will be remembered, the Town Council were moved into activity on this question, do not now appear as though they will be such profitable customers as was anticipated, for they write that they are prepared to take the electric light for the officers' quarters, officers' mess, and the recreation buildings in the new barracks, if the current can be supplied to their satisfaction; but as to the general lighting of the barracks by electricity, the result of experiments elsewhere must be awaited. This is vastly different from lighting the whole barracks by electricity supplied by the Council, as it was originally stated was required; and those who opposed the scheme can now see that the first indications point to the reasonableness of the waiting policy which they vainly urged upon their colleagues.

Mr. Padbury, a member of the Hampstead Vestry, actually had the audacity, at last Thursday's meeting, to move that gas-lamps be substituted for the electric arc lamps in the Finchley Road. His action was prompted by the enormous estimate of £1014 for these 24 lamps submitted for the Vestry's approval; whereas, according to him, the previous year's cost was but £800, and this was one-sixth as much as was paid for the gas lighting of the whole parish. Mr. King seconded the motion; remarking that he considered the lighting of that little bit of road cost £900 more than it need. Mr. Thwaites, the Chairman of the Electricity Committee, declared that there must be some mistake in the figures supplied by the Vestry Clerk; but, apart from that, it would be suicidal for the Vestry to abandon their street lighting while the department paid its expenses—indeed, next year he hoped there would be a surplus after the public lighting had been paid for. On being appealed to for figures, Mr. Cottam, the Engineer, said the cost of these 24 lamps was a little less than £30 per lamp per annum, including interest, maintenance, &c. Mr. Johnson pointed out that this estimate of £1014 was not the actual cost of producing the light, but was the price charged by the Electricity Department as a trading concern, and it included profit. It would be absolutely absurd for the Vestry, after incurring such enormous expense, to abandon their public electric lighting yet, even though there might at present be two questions as to the ultimate success of the scheme. Other members joined in the discussion; but the motion was eventually lost by an overwhelming majority—several opponents of the Electric Lighting scheme refusing to support such a radical change as Mr. Padbury proposed. It was, they argued, one thing to criticize payment for luxuries, but another to dispense with those luxuries altogether, until they have proved themselves, by a lengthy experience, unworthy of being so designated. Yet it may be asked: "How much additional proof is wanted?"

METROPOLIS WATER SUPPLY.

The Report on the East London Water Inquiry.

In the "JOURNAL" for the 11th ult., we gave the conclusions arrived at by Colonel W. Ducat, R.E., and Dr. F. W. Barry as the result of their consideration of the evidence adduced at the inquiry held by them on behalf of the Local Government Board in October last in regard to the alleged failure of the East London Water Company's supply in the summer of 1895. It may now be of interest, in connection therewith, to give some extracts from their report, of which those conclusions are the final portion.

The Inspectors give first of all a few facts and figures with respect to the accused Company. They show that their estimated maximum daily available supply was 53 million gallons, for an estimated population of 1,202,557. The average daily supply was from 35 to 36 gallons per head; and the quantity of water required daily, from 43 to 45 million gallons. The storage capacity of the reservoirs was 741 million gallons, inclusive of water lodged in the gravel between the puddle walls and the inner slopes of the reservoirs, or 615 million gallons exclusive of that water. The following is a concise record of the course of events which gave rise to the inquiry. On May 26, 1895, all the Company's reservoirs were full; on June 28, they were half empty, and the supply of water was cut off for nine hours at night; on July 13, water was supplied for three hours a day only; on July 28, it was increased to six hours; on Aug. 17, it was further increased to eleven hours; and on Sept. 8, the constant supply was restored. The instructions given to the Inspectors were that their inquiry was to be directed to the following matters: (1) The circumstances connected with the deficiency of water supplied in the Metropolitan area comprised in the districts of the East London Water Company and the Leyton Urban District Council; (2) the effects of the deficient supply as regards the public health; and (3) the means which should be adopted with the view of preventing a recurrence of any such deficiency. The case was argued before them under these headings; and in this way they treat the arguments and evidence.

Taking the first heading, the following is a brief summary of the contentions urged against the Company with respect to this section of the inquiry: On behalf of the Vestries and the Leyton District Council, it was contended (1) that there was, during July and August, 1895, widespread scarcity of water throughout the whole of the Company's district; (2) that they did not, in the circumstances, use every means in their power to maintain a constant supply; (3) that they at that time unduly favoured one class of customers to the detriment of another, to the pecuniary benefit of the Company; (4) that they had been to blame for delay in the construction of additional means of storage, and the provision of additional pumping power; (5) that the damage to the mains and to the consumers' pipes during the great frost of 1895 was due to the initial error of the Company in laying their mains too near the surface; and (6) that the waste, subsequent to the frost, from the mains and from the consumers' pipes might have been remedied much earlier if there had been efficient inspection. On behalf of the London County Council, it was contended that the failure of the Company to give their consumers a constant service supply was not attributable to unusual drought, and that the want of more storage had nothing to do with it, but that it was due either to the "shattered mains" of the Company, which they had not repaired, or to leakage from consumers' pipes, owing to the neglect of the Company to put into force the regulations against the householder prescribed by Act of Parliament, because it was cheaper to pump the water to waste than to enforce the regulations. The Inspectors deal with all these contentions in detail. The Company at once admitted that the constant service was interrupted as regards some two-thirds of their district not supplied by constantly charged mains; but in the other third, there was no intermission whatever. With respect to the charge that the Company did not use every means in their power to maintain a constant supply, no witnesses were brought forward by the Vestries in support of it; but it was proved to be unfounded by those called for the Company. As to the accusation that undue preference was shown to persons receiving their supply by meter, the Company answered it by showing that about two-thirds of the meter supplies, including most of the large trade supplies, were upon the fire-mains; but the rest, being connected with the ordinary mains, had to suffer curtailment. As to the allegation that the Company supplied the Tottenham Local Board with water during a period when they were unable to give a proper service to their own district, the Company replied that the supply to Tottenham was compulsory upon them; but it was reduced in the same proportion as that to the whole of the district. The Company had been blamed for delay in the construction of additional means of storage and the provision of more pumping power. But they pointed out that, owing to the rejection of their Bill in 1893, they could not do this. The damage to the Company's mains and the consumers' pipes during the great frost had been attributed to the initial error of laying the mains too near the surface. On behalf of the Company, it was admitted that, in the Hackney district, 431 openings had been made with the view of remedying defects in the mains, and 1110 for repairing those in the consumers' pipes, between Jan. 1 and April 30, 1895. It was further admitted that the depth of the mains varied from 2 to 5 feet below the surface; and that if they were laid 3 feet below the surface, they were practically unaffected by frost. It was stated, however, that there were no very shallow mains in the country districts; and that any that there might be were situate within the Metropolitan area, where there had been very few cases of mains frozen at all, except in the Hackney district. It was further admitted that the communication-pipes leading to the houses came off, as a rule, from the upper part of the barrel of the main; and that, in consequence, if the mains themselves were too shallow, the point of junction with the communication-pipe would also be too near the surface. It was, however, stated that, for a great many years past, the Company had insisted upon all communication-pipes being laid at a minimum depth of 2 ft. 6 in. when in the "open air." As to the assertion that

was made that the waste subsequent to the frost might have been remedied earlier than it was if there had been efficient inspection, evidence was given on behalf of the Company to the effect that all the mains in the Metropolitan portion of their district were repaired by the 8th of April, and those outside the Metropolitan district by the 19th; that, as regards consumers' communication-pipes, the Company, in addition to the ordinary staff of waste inspectors (some 40 to 50), had employed a large number of additional inspectors, bringing up the total staff to 100, during the period commencing immediately after the break-up of the frost until the time when the constant service was cut off; and that these inspectors made more than 50,000 inspections, not only once, but twice and three times. Where pipes and fittings were found defective, owners were served with notices calling upon them to repair and make good. After a reasonable time, a second inspection was made; and where defects still existed, further notices were served. It was only after a third notice that in a few cases the water supply was cut off, and proceedings were instituted against the offenders. The reason given for the Company's leniency in these cases was that, owing to the large number of breakages in the lead pipes after the frost, plumbers could not be found in the district in sufficient numbers to carry out the repairs more rapidly. The charge made on the part of the London County Council that the failure of the Company to give their consumers a constant service supply during July and August was due to the non-repair of the shattered mains, was supported by evidence given by Mr. A. R. Binnie, M.Inst.C.E., their Chief Engineer. The Inspectors, however, came to the conclusion that this theory had not been proved, nor had it been sustained by witnesses called at the inquiry. On behalf of the Company, it was contended that the scarcity of water in those months was due to the following circumstances: (1) Exceptional waste beyond that of ordinary years; owing to the unavoidable delay in repairing fractures in the consumers' pipes brought about during the unusually long and severe frost of the previous winter, and to an excessive amount of garden watering during the hot month of June. (2) An unprecedented drought in the Lea Valley, which occurred during the first six months of 1895, leading to decrease in the volume of the river, and to consequent abnormal consumption of the reserve supply in the storage reservoirs. Means of storage insufficient to enable the Company to meet the combined waste and deficiency of water noted under headings (1) and (2), owing to the rejection of the Bill promoted by them in 1893. They further contended that, notwithstanding the intermissions in their water service, little or no inconvenience would have been experienced by the consumers if they had been provided with efficient means of domestic storage. The Inspectors deal with all these contentions, and then conclude this portion of their report by expressing the opinion that the necessity for suspending the constant service was forced upon the Company by the exceptional circumstances cited by them; and that the inconvenience experienced by the consumers was much aggravated by the want of proper means of storing water upon the premises.

Coming to the subject of the effects of the deficient supply as regards the public health, the Inspectors remark that the contentions of the Medical Officers of Health, who were called before them, taken as a whole, were to the effect that the death-rate from all causes, and from diarrhœa and allied diseases, in their respective districts, during the scarcity of water, exceeded the usual rates for the Registration County of London for this time; and that these excessive rates were due to the conditions induced by the scarcity. It was, however, generally admitted that both the general and the diarrhœal death-rates in the sanitary districts comprised within the area of the East London water supply were, as a rule, higher than those which obtained in the Registration County of London. From the statistics laid before them, the Inspectors came to the conclusion that, in regard to deaths from all causes or from diarrhœa only, in the Company's area as a whole, there was no evidence to show that the rates were influenced, or the public health detrimentally affected, by the deficient water supply.

On the third head of the inquiry, the Inspectors report as follows: The conditions presented by the year 1895 were very exceptional. An unprecedented drought following a most unusually severe frost created difficulties not likely to be exceeded in the future; and it may be assumed, for purposes of calculation, that a maximum strain was this year put on the resources of the Company. By January, 1896, it is expected that the works now in progress in connection with the Race-course reservoir and the additional pumping plant will be completed.* These works will give an additional storage capacity for 200 million gallons, as well as power to obtain a further 3 million gallons a day from the chalk. In addition to these works, other reservoirs, under the powers given by the East London Water Act, 1894, are in course of construction, which will finally increase the present storage of the Company to 1200 million gallons—an amount equivalent to some 27 days' average supply. Under these circumstances, we consider that, when Parliament passed the Act of 1894, they furnished the East London Water Company with powers sufficient to prevent the recurrence of a deficiency of water in their district until such time, at any rate, as the population to be supplied shall have again outgrown the provision made.

On behalf of the Water Company it was urged that, if powers were given to them with regard to fittings similar to those conferred upon a number of corporations in the country, it would be possible very materially to reduce in the future the waste which ordinarily takes place within their district.

Incidentally, we would here refer to the advantage to the consumer of having a small storage of water in every house. It was shown that, throughout this scarcity, persons occupying houses provided with cisterns suffered no inconvenience. No doubt ill-designed and badly-placed house cisterns are open to objection from a health point of view; and nothing could be farther from our intention than to advocate any return to the old defective cisterns with their moveable wooden covers. But we do advocate the provision of properly-designed cisterns. By a "properly-designed cistern," we mean a cistern which shall be so constructed as to exclude alike the possibility of the entrance of dirt from the atmosphere and the accumulation of any deposit from the water itself, while at the same time the water in the cistern is under the same pressure as the water in the main itself. In other words, the cistern that would satisfy us is merely a local enlargement of the water-main. Such a cistern is, in our opinion, subject to none of the objections commonly urged against the use of cisterns. Under the best arrangements, there must be times when short periods of interruption of a constant service will occur; and at such times, the want of water for domestic purposes, for flushing water-closets, sealing water-traps, &c., is calculated to lead to conditions injurious to health, which should not be allowed to exist, and which a proper use of really efficient cisterns would guard against.

With respect to the contention advanced on behalf of the Vestries, that the real remedy for the defects in the Water Company's arrangements which resulted in the scarcity of the water supply in East London during July and August, 1895, is to be found in sweeping away the Water Companies altogether, and transferring all their works to the hands of a public authority, we think that the question thus raised is not one for us to consider here, and that it does not come within the scope of this inquiry.

* The report is dated Nov. 11, 1895.—ED. J.G.L.

WOLVERHAMPTON CORPORATION WATER SUPPLY.

Local Government Board Inquiry.

The Wolverhampton Town Council having applied to the Local Government Board for the issue of a Provisional Order to repeal several Local Acts, Colonel J. O. HASTED and Mr. E. P. BURD, two of the Board's Inspectors, have held an inquiry regarding the proposals. The Corporation desire, among several other matters, to extend the water undertaking by the purchase of additional land and the erection of works, and to obtain powers to borrow the necessary money for this purpose.

The TOWN CLERK (Mr. H. Brevitt) represented the Corporation; and Mr. R. C. E. PLUMPTRE appeared to oppose the application so far as it related to the extension of the water-works, on behalf of the Staffordshire and Worcestershire Canal Company and Lord Wrottesley.

The TOWN CLERK, explaining the case of the Corporation with regard to the extension of the water-works, said what the Corporation were asking for was that the present Act of Parliament might be amended so as to enable them to acquire additional lands for the purposes of their water undertaking. The water-works were purchased by the Corporation in 1867; the consideration being the payment to the Company of perpetual annuities, amounting to about £5000 a year. The undertaking of the Corporation extended beyond the municipal limits; the area of the water district being about 64 square miles, with a population of 160,000. Wolverhampton stood in a unique position as regarded the water supply, as the water was derived from one source—the Cosford pumping-station; and in order to send it to Wolverhampton, the water had to be pumped three times. It was first lifted to the surface at Cosford, then forced to the top of Summerhouse Hill, whence it gravitated to Tettenhall, and was then pumped to Goldthorn Hill—a portion of the town being supplied on the way. From Goldthorn Hill the water gravitated to other parts of Wolverhampton, and to Willenhall, Bilston, Sedgley, and Coseley. At Tettenhall there was a reservoir capable of holding 12 million gallons of water; and at Goldthorn Hill, two reservoirs of a capacity of 750,000 gallons each. At Cosford there was a yield of 3,654,000 gallons per twenty-four hours; and the wells at Tettenhall and Goldthorn Hill also yielded a small supply. When the River Worfe at Cosford was in a suitable condition, water could also be taken from that source. During the last seventeen years, the yield from the wells had decreased, while the population had increased; and in times of frost, the Corporation and consumers had been put to great inconvenience. It was to prevent this, and to ensure a better supply, that the Corporation reasonably asked that their Improvement Act might be amended. If the application were not granted, a serious difficulty might arise, as, if an accident occurred at Cosford or at the Tettenhall pumping-station, or a burst took place in the main between Cosford and Tettenhall, the whole supply to Wolverhampton and the district would be cut off. It was now proposed to sink another well within the water area of the Corporation at Dimingsdale. With regard to the site of the proposed new works, no specific place would be fixed upon, as, if the trial boreholes at Dimingsdale were unsuccessful, the Corporation would go elsewhere. It was proposed to erect an engine-house and appurtenances and put down two engines. The cost was estimated at about £30,000. But up to the present, the water undertaking had never been a burden on the ratepayers; and for the past two years, the balance of profit, amounting to £3000, had been handed over for the relief of the improvement rate. With respect to the cost, as the result of the sale of a portion of their works to the Bilston District Council, the Corporation were entitled to receive £16,750. Of that sum, £3500 was to be spent in the construction of mains from Wolverhampton to Willenhall; and deducting the balance—£13,250—from the estimated cost of £30,000, the sum of £16,750 remained, which amount would be borrowed under the provisions of the Act

Mr. *E. A. B. Woodward*, the Water Engineer, gave evidence bearing out the above statement, and said that it was absolutely necessary that Wolverhampton should have another source of supply, and he explained that it would cost more to improve the Cosford water-works than to lay down new works.

Mr. PLUMPTRE, on behalf of the Staffordshire and Worcestershire Canal Company and Lord Wrottesley, said that the canal had been in existence since 1761. By their Act of George III., they were entitled to the springs, streams, and watercourses within a distance of 500 yards of the canal; and subsequent legislation had preserved that statutory power. When the Wolverhampton Water-Works Company was formed, they were forbidden to carry on any works at a greater depth than 18 feet below the top water-level of the canal at Tettenhall Bridge. The Corporation stood in the same place as the Water Company, and no order should be made to prejudice the Canal Company.

The Inspectors then proceeded to hear evidence regarding the other matters included in the application.

NOTES FROM SCOTLAND.

From Our Own Correspondent.

Saturday.

Sheriff-Substitute Robertson, of Forfar, has issued an order in the application by Provost Vallentine and Mr. Philip, solicitor, of Brechin, in which the applicants seek to have the Brechin Gas Company interdicted from cutting off the gas supply to their premises, in consequence of default in payment. The Sheriff allows both parties a proof of their averments, and appoints the case to be enrolled, in order that a diet be fixed. Meantime, he continues the interim interdict; reserving all question of expenses. In a note, his Lordship says that it appears the Company is not authorized or limited by any Act of Parliament—being a private Company. He had been asked to refuse the interdiet at once, without any proof either as to the quality of the gas supplied or as to course of dealings between the parties, on the ground that the gas had been consumed, and must therefore be paid for. No doubt the general rule in law was, that if delivery were taken of an article or consumed by the buyer, then the price must be paid; and this general rule was much in defenders' favour. At the same time, he did not see his way, without further investigation, to dismiss the application. The defenders' position might be a strong one, in respect they said: "If you do not like our gas, you need not take it; but if you take it, you must pay for it." He hardly thinks they could put their case so high as that. Proof must be taken; and he must inquire into the quality of the gas supplied, the nature and frequency of the complaints, and generally into the course of dealing between the parties before he can be in a position to grant or refuse the interdict. An appeal to the Sheriff-Principal against this order has already been intimated.

The subject of the acquisition of the Brechin Gas Company's undertaking was before the Town Council on Monday last. The burgh Treasurer moved that the Special Committee in charge of the subject be empowered to employ a qualified expert to value the works of the Company, if the Committee thought that this was necessary. He believed that if they could acquire the Company's works at some reasonable figure, they would effect a great saving as compared with putting up new works for themselves—these being the only two courses open to them. It was their duty to take action in preventing the lighting of the town being exploited for the benefit of a private Company, the shareholders of which had drawn extravagant dividends from the consumers. The Provost seconded the Treasurer's motion, which he considered a reasonable one. A member of the Council thought they might as well appoint someone to go into his premises and value his stock, as to send an expert to value the works of a private Company. They ought to appoint a Committee, with powers to negotiate with the Directors of the Company; and he moved to that effect. Another member moved that they delay taking any action for this season, because the Gas Company had got a severe lesson recently, which might have a beneficial influence upon them. At the same time, he could say, honestly, that the Company were not doing their duty to the consumers. The Treasurer's motion was adopted by a majority. Another meeting of the Town Council was held on Wednesday night, at which the Treasurer said that some doubt had been expressed as to whether the Gas Company would allow their works to be inspected by an expert. He had now to say that, if they did so, it must be as an outsider; but they were partners of the Company, and were therefore entitled to inspect the works. He asked them to give the Committee full powers in the matter. The Provost thought that if the Company had refused an inspection, it might have been different; but he did not think it would be wise to force them in such a way. He thought there would be no difficulty in making an examination. Accordingly nothing was done. The Town Council do not seem to be adopting the most straightforward course in approaching the subject of transfer, nor are they quite consistent. If in one breath they say that the Company is a private one, and in another that they are themselves partisans in the concern, there is a want of agreement between the two positions, so far as the Council are concerned. The works of a private company, they could not forcibly enter—not even although they had statutory powers. Partnership in the Company would do them no good either. Even if they should hold shares of the Company in trust, a minority could not over-ride the wishes of the majority of the partners. Either way, therefore, there is not much prospect of success for the Town Council, so long as they keep on their present tack. How they should approach the subject, it is not for me to say, as I am not the adviser of the Town Council.

A small-debt action was heard in the Justice of Peace Court in Dundee on Monday, which raised the old question of the liability of a gas consumer to pay according to the reading of the meter. A lady resident in Broughty Ferry was sued by the Broughty Ferry Gas Commissioners for £5 4s., restricted to £5, for gas supplied between May and November last. Her plea in defence was that the charge was a ridiculous one. It appeared that during the summer, on complaint by the lady that she was not getting a sufficient supply of gas, the servants of the Gas Commissioners twice watered the meter; but that in November, a plumber discovered a leak in a gas-pipe in the attics. It was clear that the gas was not consumed; and the question was whether the Bench should not give decree for a modified sum. On behalf of the Company, this was opposed, on the ground that it would be setting a dangerous precedent. The Solicitor for the lady argued that the statute merely said that the meter-index was to be *primâ facie* evidence of the amount consumed; but that if the Court were satisfied that the gas was not used, it was within their power to make any deduction they might think proper. Theoretically, he was right; but before such a doctrine could be put into practice, there would require to be a corrupt bench—that is to say, one which, notwithstanding a person had proved that 20s. was due to him, would give decree for 10s. Such sophistry would not do, even in a Justice of the Peace Court; and decree was given for the amount claimed. The question as to whether the Commissioners would give a modification was then raised; and there is every probability that now they have got decree they may. This will, however, I daresay, be decided largely upon whether the lady can recover anything from the owner of the house, who, unless she has agreed with him to the contrary, is responsible for the gas-fittings.

A curious instance of the unreliability of the ordinary newspaper correspondent is given in a Dundee paper this week, when it is stated that the Perth Gas Commissioners have accepted the offer of Messrs. J. Miller, Sons, and Co., of Glasgow, "to supply sulphate of ammonia, at £7 17s. 6d. per ton, for the works." Explanation is unnecessary.

The Coatbridge Town Council on Thursday appointed a Committee to inquire as to the advisability of the Council acquiring the gas and electricity works, with a view to working them in the public interest. If gas transfers go on at this rate—and I hear of another as being proposed—there will shortly be no gas companies of consequence left. As it is, the Coatbridge Gas Company is the only one remaining in Scotland which works under an incorporating Act of its own. The only other Company now under statutory authority is the Musselburgh Gas Company, which holds a Provisional Order under the Gas Orders Confirmation Act of 1887. There are 36 municipal gas undertakings in Scotland, to which number several will be added this year; but there will still be over 200 companies. About 30 of these are limited liability concerns; and the remainder are no more than private co-partnerships. It is observable that the statutory and limited liability companies have been those which are most in demand by municipalities—I suppose on account of their being the better-going concerns. It is wonderful to think that there should be over 200 gas undertakings in Scotland which have no statutory authority, but simply conduct their business upon the footing of contract as between man and man. Almost without exception, too, they are very successful. When it is considered that a better price is obtained for a statutory than for a non-statutory company's undertaking, it is likely that, should the present movement for acquiring gas undertakings spread, there will be a crop of applications by companies to obtain Provisional Orders; and more particularly so if harassing tactics—such as appear to have developed at Brechin—should become common.

One of such applications has come to light this week. After having been on what may very properly be called the down-grade in the matter of efficiency, for some time, an effort is to be made to rejuvenate the gas-works at Fort William. The works belong to Mr. Hugh Mayberry, of Glasgow; and he has made application to the Local Government Board for a Provisional Order, under which to carry on business in future. Objection having been taken on behalf of the Police Commissioners, an inquiry was held yesterday, which was presided over by Colonel Yorke, of the Board of Trade. The Commissioner visited the gas-works first, and afterwards heard evidence at considerable length, both for and against granting the Order. The proceedings were watched on behalf of the newly-formed Electric Lighting Company. Colonel Yorke will, of course, report the result of his investigation direct to the Board of Trade.

The Paisley Town Council on Tuesday considered the proposals by Mr. George R. Hislop, the Engineer and Manager of the Gas-Works, for extensions. It was agreed to proceed with certain extensions of works and mains to the amount of £7744. The Council also considered the offer of the Oil-Gas Enrichment Company to introduce plant into the works. The proposal was to construct apparatus capable of producing 162,000 cubic feet of oil gas per 24 hours, from crude oil of 867 sp. gr., which would enrich 1,800,000 cubic feet of coal gas from 21 to 27 candles, and would be equivalent to the work of 60 ordinary retorts distilling shale. The quantity of oil estimated per day is 7·36 tons. The offer was accepted. It was then proposed to apply for powers to borrow £20,000 to meet the capital expenditure upon the extensions; and it was suggested that the whole cost should be defrayed from revenue. The latter proposal having been defeated, a discussion took place. It was ultimately agreed to give the whole subject of finance further consideration. The Council then took up consideration of the application by the Renfrew Town Council for a supply of gas in bulk. It was reported that the estimated cost of laying a direct main from the Paisley Gas-Works to Renfrew Cross was £5283; that, in order that that sum might be redeemed in 25 years, it would be necessary to make the net cost of gas 1s. 10·414d. per 1000 cubic feet; and that if the Corporation of Renfrew, who charge 3s. 9d. per 1000 feet at present, paid 2s. 7d., there would be a profit to the Paisley Corporation of £465 1s. 6d. The profit to the Renfrew Corporation, at 1s. 2d. per 1000 feet upon 13 million cubic feet, would be £775, less £181 7s. allowed for leakage; or a net profit of £593 13s. These results are based on the condition of the future price to Renfrew being raised or lowered according as the price in Paisley was advanced or reduced. A Committee was appointed to confer on the subject with the Renfrew Corporation. A meeting between Committees of the two Corporations was held subsequently, at which the terms were regarded on both sides as satisfactory; and the Committees are to report to their respective Corporations. This occurred on Tuesday; but on the previous evening (I suppose before the Paisley terms were disclosed), the Renfrew Corporation had appointed a Committee to confer with the Glasgow Corporation, as to the terms on which they could give a supply of gas to the burgh.

There was a little breeze at a meeting of the Millport Police Commission this week, over the terms which had been agreed upon between the Committees representing the Gas Company and the Commissioners, regarding the fixing of the valuation of the Gas Company's undertaking. Some of the Commissioners pointed out that the first agreement was that the expense of the reference should be borne mutually, but that the Committee had recommended that, in the event of one of the parties resiling from the matter after the reference, they should bear the whole cost. This latter proviso was objected to. One of the members of the Committee asked if it were intended to pass a vote of censure on the Committee, because if so, he would resign. After much wrangling, the recommendation of the Committee was agreed to.

Quite a storm took place at the meeting of the Dunfermline Town Council on Monday, over a question which arose regarding the employment of members of the Council who belong to the legal profession as presiding officers at pollings. It was reported that two such gentlemen acted in the recent vote about the adoption of the Burghs Gas Supply Act; and that they had each been paid £2 2s. for their services. The legality of the payment was objected to, as being struck at by the self-denying ordinance; and a warm discussion ensued. As, however, it was proved that it had been the rule to employ all local practitioners, whether members of the Council or not, in elections, the payments

were passed this time; and notice of motion was given to put a stop to the practice in future. It was reported that the cost of the vote to the burgh was over £32.

The Police Commissioners of Kilsyth have accepted an offer by Mr. Workman, of Saltcoats, to fit up an installation of a regenerative system of retort-firing in the gas-works there. Other improvements are also to be introduced.

At a meeting of the Grangemouth Police Commissioners this week, one of the members initiated a conversation regarding the quality of the gas supplied by the local Company. The Company, he said, had suggested that the street-lamp burners should be overhauled. This had been done; and all the governors had been sent to Edinburgh to be tested and repaired. He was afraid the Company would require to look nearer home for the cause of the bad lighting, as it was not the burners or the governors that were defective. It was pointed out that the position of the Gas Company was that the gas they were supplying was equal in illuminating power, if not superior, to that which they undertook in 1892 to furnish. There was some further talk about want of pressure; and then the originator of the discussion wound it up by saying they ought to let the Gas Company know that they were alive to what should be done with the street-lamps, and that if the Company had not supplied them with bad gas, there would have been no complaint. Just so; all that the gentleman wanted was simply an opportunity of having a snarl at the Gas Company. He picked his subject, choosing one which would appeal to the public, but which could not be proved.

The Denny Police Commissioners have this week resolved to introduce Hislop's patent system of regenerative firing into their gas-works, and have ordered the retorts from the Glenboig Fire Clay Company. Last month there was an increased consumption of gas over the corresponding period of last year, of 127,200 cubic feet.

The Royal Scottish Academy Exhibition—the premier fine-art exhibition in Scotland—has been lighted up with incandescent gas-burners, arranged in clusters. There were formerly 420 gas-burners, of the ordinary type, arranged in rings in the octagons of which the galleries are made up. These have been replaced by 70 incandescent gas-lamps; and the light is not only much more brilliant, but it enables the colours to be more easily distinguished.

An arrangement has been made in Montrose, whereby, instead of the Town Council fitting up a photometer for testing the gas supplied by the Gas Company, they are to have the use of the Company's photometer at any time they please. The Town Council felt that the cost of a new photometer would be too much for them; but Mr. Douglas Hall, the Manager of the Gas Company, got them out of their difficulty by offering them the use of the Company's apparatus, which they accepted.

CURRENT SALES OF GAS PRODUCTS.

LIVERPOOL, *March* 14.

Sulphate of Ammonia.—The market remains very steady; but any attempt to score an advance has not met with success. There has been a fair business passing at current prices; but the disposition of buyers is to postpone their purchasing rather than by any precipitancy to force an advance. The home demand continues satisfactory; and it appears to be larger than last year, on account possibly of the earlier season. So far, the formal ratification of the Nitrate Combination has not affected the price of sulphate of ammonia; but it can only be a matter of time when prices of the two articles must adjust themselves to each other. Buyers would seem to be realizing this; and there is considerable interest in the forward position. There is, however, no inducement, in the present range of values, for makers to sell ahead; and meantime they are not offering.

Nitrate of Soda remains steady at 8s. per cwt. for good, up to 8s. 1½d. for fine quality on spot. Due cargoes of ordinary quality are worth about 7s. 11¼d. per cwt.

LONDON, *March* 14.

Tar Products.—A slight improvement has taken place in benzols; and, for early delivery, 2s. is again possible for 90's. For forward delivery, however, buyers will not advance on recent rates. Carbolic acid is well inquired for; and buyers are generally disposed to buy three or four months ahead. There seems every reason to expect that present prices will be maintained, if not improved upon. Business has been done at 2s. 3½d. for 60's. There is not much fresh business doing in pitch; buyers being pretty well covered for January-June, considering it too early to buy for next season. The demand for naphthalene, either in its crude or pressed condition, is great, and should lead to better prices. There is a good deal of inquiry for pyridine; and next season will probably see higher prices for this.

Prices current during the week are: Tar, 18s. to 22s. 6d. Pitch, 32s. to 34s. Benzols, 90's, nominal, 2s.; 50's, 1s. 8d. Toluol, 1s. 6d. Solvent naphtha, 1s. 2½d. to 1s. 3½d. Crude, 30 per cent., naphtha, 9½d. Creosote, 1d. Naphthalene, pressed, 50s.; drained, 27s. 6d. Cresylic acid, 1s. 2d.; brown, 10d. Carbolic acid, 60's, 2s. 3½d. Anthracene, "A," 11d. to 1s.; "B," 9d. to 10d.

Sulphate of Ammonia has not been so far beneficially affected by the Nitrate Combination, which has now been accomplished; but, while there is no probability of the return of the price of the early part of 1895, there should certainly before long be better rates available. To-day's price may be taken as £8 5s. to £8 10s., less 3½ per cent. Gas liquor is being offered at 6s. to 7s. per ton.

COAL TRADE REPORTS.

From Our Own Correspondents.

Lancashire Coal Trade.—No material change is noticeable in the position as regards round coals; all descriptions continuing in slow demand, with supplies plentiful, although the output at most of the collieries is restricted to an average of about four days a week. House-fire qualities have, perhaps, been moving off rather more freely during the last few weeks; but the business doing is still only of limited weight considering the time of year, and late rates are barely being maintained. Common round coals, suitable for iron-making, steam, and general manufacturing purposes, notwithstanding the restricted production, continue to hang upon the market, with prices weak; very low figures being taken to effect sales of anything like quantities. For the better qualities of engine fuel, supplies of which are not at all excessive, there has been a fair demand; large consumers showing in many cases rather an anxiety to enter into forward contracts. Prices consequently have assumed a firmer tone; advances of 3d. per ton being quoted in some instances. Common slack, however, continues plentiful, with prices as low as ever. At the pit mouth, best Wigan Arley averages 10s. to 10s. 6d. per ton; Pemberton four-feet and seconds Arley, 8s. to 8s. 6d.; common house coal, 7s.; steam and forge coals, 6s.; the better sorts of engine fuel, 4s. 6d. to 5s.; and common descriptions obtainable at 2s. 9d. up to 3s. 3d. In the shipping trade, business continues very slow, with no better prices, and 6s. 9d. to 7s. per ton for common steam coal, up to 7s. 6d. to 7s. 9d. for better qualities, remain the average selling prices, for delivery at the ports on the Mersey.

Northern Coal Trade.—The demand has been a little better for shipment this week, for both steam and household coals; but the local inquiry seems to have been less. As there is also naturally now a declension in the use of gas coal for illuminating purposes, the position of the coal trade has been a little irregular. Best Northumbrian steam coals are quoted at 7s. 9d. per ton, for prompt delivery; and the general demand, though a little improved, still only allows the working of short time at most of the collieries. Second-class steam coals are about 7s. 3d. per ton; and steam smalls, 3s. 6d. But for delivery over the shipping season, the quotation is still 8s. 3d. per ton for best steam coal; and about 7s. 6d. to 7s. 9d. for second qualities. Manufacturing coals are steadier; the demand having been improved by the fuller activity of late in several of the factories and shipbuilding yards. There have also been larger quantities taken for locomotive purposes; the traffic on the local railways being very much in excess of that usual at this time of the year. In regard to gas coals, the consumption is good for the season of the year. The price is generally about 6s. 3d. to 6s. 6d. per ton f.o.b. for occasional cargoes. Several very important contracts are now in course of negotiation; but the competition for these is very keen. Coke is very strong in demand; and as best qualities are rather scarce, the price is very firmly maintained. Higher rates are asked for coke to be delivered a little later in the year, when there should be a fuller demand for export. At present best blast furnace coke is quoted at 13s. 6d. to 13s. 9d. per ton delivered at the works; but for export, the general quotation varies from 14s. 6d. to 15s. 6d. per ton f.o.b. At no period has there been a larger consumption of blast furnace coke. There is a limited output of gas coke now compared with what there was two months ago, and the stocks are reduced in some quarters. Prices show no alteration of moment this week; but there does not seem so large an export as usual.

Scotch Coal Trade.—There is no change to report in regard to the coal trade in Scotland. Large coal is still meeting with a dull sale; the smaller varieties being most in demand. Prices have not altered. The reduction in the miners' wages took effect last week, and has been everywhere accepted; but efforts are being made to organize the men, with a view to making a demand for an increase in the autumn. A restriction in the output is also advocated in some quarters; but as in most cases full time cannot be had, much further restriction would mean starvation for the men. The prices quoted are: Main, 5s. 9d. (easy) per ton f.o.b. Glasgow; ell, 6s. 6d. to 6s. 9d.; splint, 6s. 3d. to 6s. 6d.; and steam, 7s. 6d. The shipments for the week amounted to 119,875 tons—an increase over the preceding week of 2695 tons, and over the corresponding week of last year of 24,110 tons. For the year to date, the total shipments have amounted to 1,116,000 tons—an increase as compared with the same period of last year of 150,281 tons.

Local Authorities and the London Water Question.—There is apparently to be some opposition from the governing bodies of London to the scheme which is under the consideration of the London County Council for bringing a supplemental supply of water to London from Wales. Last Saturday, the Marylebone Vestry posted a circular to the various Local Authorities of the Metropolis, asking them to send representatives to a conference which it is proposed to hold shortly to take into consideration the whole question of the Metropolitan Water Supply. In this circular, the conveners of the conference point out that, having regard to the exceedingly heavy burdens which the ratepayers already have to bear, the enormous expenditure of close upon £39,000,000 proposed to be incurred by the Council must be viewed with considerable interest, if not alarm. It is further pointed out that, when the new supply is brought to London, it would have to be distributed through the existing Companies' mains; thus necessitating the additional purchase of that portion of their property. It is proposed that resolutions shall be submitted to the conference declaring that, in view of the report of the Royal Commission, the scheme of bringing water from Wales should not be proceeded with until proper inquiry has been made as to what economy of the existing supply could be effected by using unfiltered water for sanitary purposes, and the probable cost; that it is desirable to bring sea water to London for sewer flushing, street watering, and other purposes, but that such undertaking should be in the hands of a public authority; and that, should the Water Companies' interests not be purchased, an obligation should be imposed upon them to reduce their charges, in the event of the scheme for bringing sea water to London being carried into effect, as regards those premises supplied therewith. On the other hand, the London County Council have been issuing a circular-letter to all the Town and District Councils throughout the country, asking them to bring their influence to bear in supporting the second reading of the Council's Bills, on the ground that the principle is of great importance to local authorities generally. As a result of the issue of this circular, a large number of members of the House of Commons have received resolutions from the local authorities in their constituencies to support the second reading of the Bills.

Sale of Shares.—Messrs. Alexander, Daniel, Selfe, and Co. have recently offered for sale £15,000 of Bristol Water Company's stock. This was part of the 7 per cent. maximum ordinary stock, amounting to £340,000, created under the Company's Acts, 1888 and 1889, and consolidated by resolution of the proprietors passed on Feb. 2, 1895. The reserve price was £146 per £100 of stock; and there was a very brisk competition for the various lots. The prices given varied from £150 to £150 17s. 6d.; the average being about £150 6s. 6d. The total amount realized was £22,549 2s. 6d.

Rothwell Gas Company.—The shareholders of this Company have reason to be satisfied with the working of the concern during the past half year. After meeting all charges and incidentals, there is a surplus profit of £61 to be carried forward. That the public have great confidence in the Company is shown by the fact that 250 additional 7 per cent. £10 shares which have been sold realized a gross premium of £1081. The Directors are contemplating further concessions to the consumers at Oulton and Woodlesford. Already a discount of 2d. per 1000 cubic feet has been allowed; and this it is proposed to increase to 7d.—making the net price 3s. 11d.

Withdrawal of the Opposition to the Guildford Gas Bill.—As a result of a second conference between the Gas Committee of the Guildford Corporation and the Directors of the Guildford Gas Company, the opposition of the Corporation to the Company's Bill now before Parliament will be withdrawn. We learn that the Company have agreed that the illuminating power and pressure of the gas shall be increased, and that the standard price shall be put at 3s. 6d. instead of 3s. 10d. per 1000 cubic feet—no extra dividend to be claimed so long as the price in the borough exceeds 3s. These concessions only left the question of the purchase clause which the Town Council proposed should be inserted in the Bill; and the Company could not consent to this provision upon any terms without fighting out the matter in the House of Commons. In consideration of the other important alterations conceded by the Company, the Council have resolved to withdraw their petition.

New Joint-Stock Companies.—The Corsham Gas Company, Limited, has been registered with a capital of £3800, in 190 shares of £10 each and 380 shares of £5 each. The undertaking was constituted by deed of settlement dated Nov. 14, 1851. The Whitchurch (Salop) Gas Company, Limited, with a capital of £30,000, in £5 shares, is to acquire the undertaking of the Whitchurch and Doddington Gaslight and Coke Company upon the terms of an agreement, and to carry on the concern. The Wickless Oil-Lamp and Gas-Economizer Syndicate, Limited, with a capital of £15,000, in £1 shares, is to enter into an agreement with one Oldenbourg, and to carry on business as manufacturers of, and dealers in, lamps and apparatus for economizing the consumption of gas. The Pará Gas Company, Limited, with a capital of £108,435, in £5 shares (5000 preference), is to acquire and carry on the business of the Pará Gas Company, Limited, and to adopt an agreement with the old Company and its Liquidators. The business of Messrs. Henry Balfour and Co, engineers and ironfounders, Leven, Fifeshire, has been converted into a limited liability Company. The capital is £10,000, divided into 580 preference, and 420 ordinary shares, of £10 each, in both classes of stock.

The Cost of the Litigation between the St. Olave's Board of Works and the Southwark and Vauxhall Water Company.—At the meeting of the St. Olave's Board of Works last Tuesday, the Clerk reported that the law costs in connection with the recent litigation between the Board and the Southwark and Vauxhall Water Company (see *ante*, p. 283) amounted to £464, which the Board would have to pay; but this sum would, he said, cover the work of reinstating the wood pavement. Mr. Shand said it was a great shame that this result should have happened. The Board had a first-class case, but it was spoiled by their District Surveyor, who told in Court quite a different story from that which he told before the commencement of the action. They had been "sold" all round; for even their Counsel threw up his brief. He (Mr. Shand) would not be afraid to fight the Company on the same point again. Mr. Potton said the Board never had a case at all. The District Surveyor was obliged to state what, in his opinion, had caused the water to escape; and he said that it was the result of the action of the frost on the wooden plug—the plug slipping out of its socket. If witness had stated anything different from this, he would have told an untruth; and to blame him for speaking the truth would not encourage others in doing their duty. The subject then dropped.

The Notts. County Council and the Water Scheme for Nottingham.—The Notts. County Council are in a peculiar position in regard to the water scheme for the carrying out of which the Nottingham Corporation are now applying for powers. They want a considerable quantity of water from the Corporation for their projected new asylum at Radcliffe-on-Trent; but they are also desirous of opposing their scheme. At the quarterly meeting of the Council last Tuesday, the Asylums Site Committee presented a report, in which they recommended that the seal of the Council should be affixed to an agreement with the Corporation for the supply of water. By this, the latter body undertook to furnish the new asylum with an ample quantity of water, at a minimum pressure of 50 lbs. to the square inch, at the rate of 7d. per 1000 gallons. In the agreement, several members saw an obstacle to their opposition to the Nottingham scheme; and it was generally thought that it would prejudice their opposition when they appeared at the Local Government Board inquiry. It was also argued that the Corporation were not in a position at the present time to give a supply, so that there was no reason for hurrying with the matter. Alderman Denison, the Chairman of the Committee, could not see that they would jeopardize their case in any resistance to the scheme by the action proposed, as the agreement was a perfectly unconditional one to supply water at a certain price; and water at that price they were bound to supply, even "if they went to the Falls of Niagara to get it." A long discussion was wound up by the adoption of the recommendation to affix the seal to the agreement upon the insertion of words to the effect that the Corporation give an undertaking, to be approved by the Chairman of the Council, that this shall be without prejudice to any course the Council shall think proper to take in regard to the water scheme.

The Incandescent Gas-Light Company's Dividends.—The Incandescent Gas-Light Company, Limited, have declared a dividend of £7 4s. 6d. on each preference share, and 3s. 9d. on each ordinary share; and the English Incandescent Gas Share Company have declared an interim dividend of 15 per cent.

The Waste of Water at Salisbury.—The Salisbury City Council have resolved to adopt Part III. of the Public Health Acts Amendment Act, 1890, in order to enable them to more effectually deal with the waste of water in the city through defective fittings. The resolution will come into operation on April 20.

The Proposed Purchase of Ashford (Kent) Gas-Works.—The Ashford District Council have considered the proposal of the Ashford Gas Company to incorporate their concern; and the question of purchasing the undertaking has also been debated. After a long discussion with closed doors, it was resolved to take the necessary steps for obtaining parliamentary powers to acquire the gas-works.

Rugby Gas Company.—At the recent annual general meeting of this Company, the Directors reported that the profits for the past year amounted to £4817; and they recommended a dividend on the second half at the rate of 12 per cent. per annum—making, with the interim dividend of 11½ per cent., a total of 11¾ per cent. for the year, free of income-tax. It was decided to call up £3 per share on the partly-paid shares, in order to carry out extensions to meet the growth of the town. With regard to the works (which are under the management of Mr. C. Meiklejohn), 7517 tons of coal were carbonized, costing £4625; and the residuals realized £2766. There were 52¼ million cubic feet of gas sold during the year. The report was adopted.

South London Vestries and the Water Question.—The Lambeth Vestry, at a meeting held last Tuesday, re-affirmed a previously expressed opinion that the supply of water should be taken out of the hands of the present Companies, and that the Water Transfer Bills now before the House of Commons would afford, with certain modifications, the means of settling the water question in the present session. The members for the several divisions are to be requested to put these views before Parliament. Mr. White, while agreeing that a change was required, strongly objected to the supply of water being placed in the hands of the London County Council, as this body had, he said, already too much to do. At a meeting of the Camberwell Vestry on the same day, a similar resolution was passed; while the Bermondsey Vestry recorded an opinion in favour of the creation of a Water Trust, and decided on petitioning the Government to promote legislation in this direction.

Loughborough Gas Company.—At the annual meeting of this Company last Tuesday, the Directors recommended the declaration of dividends for the second half of 1895 at the rates of 8 and 7 per cent. on the two classes of stock—a similar interim payment having been made in September. They also reported that the gas produced during the year showed a most satisfactory increase over the previous twelve months; and the number of new consumers bore favourable comparison with former years. Notice had been given to the public that the price of gas had been reduced 1d. per 1000 cubic feet from Jan. 1 last. The revenue account showed receipts amounting to £11,813; and an expenditure of £8796—leaving a sum of £3017. The balance of net profit to be carried forward, subject to dividends, was £2974. In moving the adoption of the report, the Chairman (Mr. W. E. Woolley) mentioned that during the year the consumption of gas had increased by 3½ million cubic feet, which represented a cash value of nearly £600. This result, the Directors considered, was due to the economical working, and also to the increase in general trade, and the prosperity of the town. The motion was agreed to.

The Cheltenham Corporation and the Gas Company.—We learn that an arrangement has been come to between the Cheltenham Corporation and the Gas Company, as the result of a conference between the Lighting Committee and the Directors, whereby the opposition to the Bill of the Company now before Parliament will be withdrawn. The matters on which the Directors are stated to be willing to make concessions are the following: (1) To allow a testing-place in the centre of the town, with the increase of the illuminating power incident to tests taken at a distance from the works—the only testing-place now recognized being that at the works; (2) to make a reduction in the amount of new capital to be obtained; (3) to allow the application of the auction clauses to the mortgage and loan capital as well as to the share capital of the Company—that is, the issue of all stocks and loans upon the open market to the highest bidder; and (4) to allow a reduction in the maximum of sulphur impurity in the gas supply. The Parliamentary Agents of the Corporation and of the Company respectively will settle the clauses to be inserted in the Bill to give effect to this compromise, which it is believed will be approved by the townspeople generally. A special meeting of the Town Council was called for yesterday to sanction the proposal.

Water-Works for Howrah.—The opening ceremony of the Howrah Water-Works took place on the morning of the 8th ult. The works are designed to furnish the municipal town of Howrah, having a population of 125,000, with a water supply of 10 gallons per head, or a maximum of 1,250,000 gallons per day. The water is taken from the River Hooghly at Serampore, where the pumping-station is located; and, after passing through the usual settling-tanks and filter-beds, it is pumped into three raised reservoirs in the town of Howrah, from which it is distributed throughout the municipal limits by 37 miles of iron pipes, varying in diameter from 16 to 2 inches. The water is served to the public by 240 stand-pipes. The supply-pipes to the elevated reservoirs are so arranged that, in the event of accidents or damage to any of the reservoirs, the supply to it can be cut off from the main, and continued to the distribution-pipes direct by a bye-pass provided with the usual fittings. The pumping plant consists of two duplicate sets of compound condensing direct-acting steam-pumps of Messrs. J. Evans and Son's duplex type. The engines for the suction and delivery into the filter-beds have steam cylinders of 8 and 14 inches diameter respectively, and a stroke of 18 inches; while those for the filtered supply have cylinders of 11 and 20 inches diameter, with a piston stroke of 12 inches. Steam is supplied to both sets of pumps by three Lancashire boilers.

A New Reservoir for Larne.—A few days since, Mr. C. P. Cotton, the Chief Engineer of the Local Government Board for Ireland, held an inquiry at Larne, with reference to a petition of the Town Commissioners for powers to take lands for the construction of a storage reservoir, and praying that they might be allowed to abandon the rights and powers conferred upon them by their Provisional Order of 1894, whereby they were authorized to take certain lands and springs in the parish of Cairncastle. At the inquiry held by Mr. Cotton before the granting of the Order referred to, several farmers and residents in the district from which the water was proposed to be taken strenuously opposed the scheme, as they held that there was not sufficient water for themselves, much less for the town of Larne. The Commissioners were impressed with this opposition; and did not proceed with the works. They now propose to construct a reservoir to contain between 9 and 10 million gallons of water; and it is intended to store simply the overplus from the present supply.

Proposed New Gasholder for Sowerby Bridge.—The Gas Committee of the Sowerby Bridge District Council have had before them estimates for a new gasholder. Messrs. R. & J. Dempster quoted £2250 for a Gadd and Mason holder of a capacity of 178,000 cubic feet, to be constructed in an existing tank at the works, and £2500 for a holder of 210,000 feet capacity. They also offered to supply a lattice-girder holder, with a capacity of 240,000 cubic feet, for £3853; or a Gadd and Mason holder for £3290. Messrs. Clayton, Son, and Co., Limited, asked £3503 for a lattice-girder holder with a capacity of 240,000 cubic feet, and £3328 for a Gadd and Mason holder. The Council at their last meeting adopted, by eight votes to four, a recommendation of the Committee that one of the large holders should be constructed, and that previous resolutions on the subject should be rescinded. It was stated that, by not utilizing the old site for the new holder, there will be an additional 240 yards of land gained for the storage of coke or retort-house extensions.

Proposed Extension of the St. Ives Water Supply.—Two schemes for improving the water supply were under the consideration of the St. Ives (Cornwall) Corporation at their last meeting. One involved the construction of an open puddle reservoir with a capacity of 3 million gallons, at an estimated cost of £1740; or if the bottom were pitch-paved or puddled, £1946. This reservoir was to be filled during the winter months from streams in the surrounding neighbourhood. The other scheme (which the Council adopted) provides for raising the water known as Fountain water at West Virgin shaft, by means of an engine pumping 6000 gallons an hour, and conveying it to a covered concrete reservoir at Hellesveor, to hold 150,000 gallons. The estimated cost is £997. The Mayor (Mr. E. Hain, jun.) stated that the present debt on water account was £23,000, on which they were paying 4 per cent. interest. Mr. J. B. Bolitho had suggested that they should spend a further £1000, and that this amount should be consolidated with the present debt; and he had offered to reduce the rate of interest on the whole amount to 3¾ per cent.

Pushing the Sale of Coke and Sulphate of Ammonia.—In the brief notice of the proceedings at the recent half-yearly meeting of the Lewes Gas Company which appeared in the "JOURNAL" last week, it was stated that the Chairman (Mr. J. Broad), in the course of his remarks when moving the adoption of the report, alluded to the efforts made by the Directors and the Manager (Mr. L. Monk) to dispose of their coke and sulphate of ammonia. In view of the fact that sulphate had dropped as much as £5 per ton, they thought it right to issue an advertisement calling the attention of the public to the price of this article and of coke. They also issued circulars to the inhabitants of Lewes, because it was felt that they were being charged a high price, probably because they were not aware that they could go to the gas-works and get what they required. Although these notices had only been issued a few weeks, they had already received orders at a fair figure. Hitherto the price had been kept up for the retail people; and then they had sometimes been obliged to take a very much lower rate for the bulk of their coke. He thought if they could induce their neighbours to buy at a fair price, they would get clear; and it would be a source of better profit to the Company. It was the same with sulphate of ammonia. There was a considerable quantity used by hop-growers, farmers, and gardeners; and it was frequently brought from town. But there, on the spot, they were able to supply it at a fair price. They were, therefore, quoting now just about the same price as it could be bought for in London; and he was glad to say satisfactory results had followed—some of their neighbours having given them orders.

The London County Council and the Water Companies.—At the meeting of the London County Council last Tuesday, Sir A. Arnold was unanimously re-elected Chairman. One of the first questions put to him after this event came from the Chairman of the Water Committee (Mr. T. H. W. Idris), who asked Sir Arthur if he could give the Council any information as to the progress of his negotiations for the purchase and transfer of the London Water Companies' undertakings. In reply, Sir Arthur stated that immediately after his appointment as negotiator by the Council on the 21st of January, he arranged to meet the Chairmen of the eight Water Companies at their respective offices; and by all of these gentlemen he had been received with great courtesy, and with a full appreciation of the intentions of the Council in appointing their Chairman to engage in negotiations for purchase and transfer. He had not met with any material discouragement. In the event of the necessary Act of Parliament being passed authorizing a transfer by agreement or arbitration, he should even hope to find a disposition on the part of at least some of the Companies to treat on so sound and reasonable a basis that, without resort to arbitration, agreements could be arranged such as might be recommended to the Council for acceptance. He believed that these proceedings had led to a better understanding between the Council and the Companies, and that, by the majority of the gentlemen who directed, with much ability and devotion, the business of those Companies, the policy of purchase and transfer was accepted as the most satisfactory—and, indeed, the inevitable—settlement of this important and difficult question.

GAS AND WATER COMPANIES' STOCK AND SHARE LIST (see ante, p. 558).

Issue.	Share.	When ex-Dividend.	Dividend or Dividend & Bonus.	NAME.	Closing Prices.	Rise or Fall in Wk.	Yield upon Investment.
£			p. c.	GAS COMPANIES.			£ s. d.
590,000	10	16 Oct.	10½	Alliance & Dublin 10 p. c.	24–25	+⅛	4 4 0
100,000	10	,,	7½	Do. 7 p. c.	17–18	+⅛	4 3 4
300,000	100	2 Jan.	5	Australian (Sydney) 5% Deb.	108–110	..	4 10 11
200,000	10	16 Oct.	4	Belgrano (B. Ayres), Limited	8⅜–9⅜	+⅛	4 4 3
100,000	Stck.	30 Dec.	5	Do. 5 p. c. Deb. Stk	95–100	..	5 0 0
200,000	5	14 Nov.	6½	Bombay, Limited	7⅛–7⅜	..	4 3 10
40,000	5	,,	6½	Do. New, £4 paid	5⅛–5⅜	..	4 10 3
380,000	Stck.	27 Feb.	12	Brentford Consolidated	280–285	..	4 4 3
210,000	,,	,,	9	Do. New	215–220	..	4 1 9
50,000	,,	,,	5	Do. 5 p. c. Pref.	—	..	—
159,375	,,	16 Dec.	4	Do. 4 p. c. Deb. Stock.	127–132	..	3 0 7
220,000	Stck.	27 Sept.	11	Brighton & Hove Original	230–235	..	4 13 8
208,820	,,	,,	8	Do. A Ord. Stk.	185–190	..	4 4 3
933,500	Stck.	27 Feb.	5	Bristol, 5 p.c. max.	123–126	..	3 19 4
420,000	20	27 Sept.	11½	British	55½–56½	+⅛	3 19 7
50,000	10	12 Mar.	11½	Bromley, Ordinary 10 p. c.	22½–23½*	+½	4 17 10
71,000	10	,,	8½	Do. 7 p. c.	19–20*	+½	4 5 0
500,000	10	14 Nov.	4	Buenos Ayres (New) Limited	9½–10	..	4 0 0
200,000	100	2 Jan.	6	Do. 6 p. c. Deb.	102–104	..	5 15 5
150,000	20	27 Feb.	8½	Cagliarl, Limited	29–31	..	5 6 5
100,000	10	27 Sept.	6	Cape Town & District, Ltd.	12½–13½	..	4 8 10
50,000	50	2 Nov.	6	Do. 6 p. c. 1st Mort.	57–59	..	5 1 9
550,000	Stck.	16 Oct.	13½	Commercial Old Stock	330–335	..	4 0 7
165,000	,,	,,	10½	Do. New do.	257–262	..	4 0 3
165,000	,,	16 Dec.	4½	Do. 4½ p. c. Deb. do.	147–152	..	2 19 2
800,000	Stck.	16 Dec.	13	Continental Union, Limited.	278–283	..	4 11 10
200,000	,,	,,	10	Do. 7 p. c. Pref.	215–220	..	4 10 11
51,620	Stck.	27 Feb.	14	Croydon Com'cial A 10 p. c.	—	..	—
157,500	,,	,,	11	Do. B 7 p. c.	—	..	—
535,000	Stck.	27 Feb.	5½	Crystal Palace Ord. 5 p.c. Stk	130–135	..	3 17 9
60,000	,,	,,	5	Do. 5 p. c. Pref.	—	..	—
486,090	10	30 Jan.	11	European, Limited	26½–27½	..	4 0 0
354,060	10	,,	11	Do. £7 10s. paid	17½–18½	..	4 9 3
5,746,590	Stck.	13 Feb.	12¾	Gaslight & Coke, A, Ordinary	302–305	–1½	4 3 3
100,000	,,	,,	4	Do. B, 4 p. c. max.	108–113	..	3 10 9
665,000	,,	,,	10	Do. C, D, & E, 10 p. c. Pf.	288–293	..	3 8 3
30,000	,,	,,	5	Do. F, 5 p. c. Prf.	135–140	..	3 11 5
60,000	,,	,,	7½	Do. G, 7½ p. c. do.	200–205	..	3 13 2
1,300,000	,,	,,	7	Do. H, 7 p. c. max.	197–202	..	3 9 3
463,000	,,	,,	10	Do. J, 10 p. c. Prf.	285–290	..	3 9 0
476,000	,,	,,	6	Do. K, 6 p. c. Prf.	168–172	..	3 9 8
1,061,150	,,	16 Dec.	4	Do. 4 p. c. Deb. Stk.	137–140	..	2 17 2
294,850	,,	,,	4½	Do. 4½ p. c. do.	148–153	..	2 18 9
908,000	,,	,,	6	Do. 6 p. c. do.	204–209	..	2 17 5
70,000	10	30 Oct.	6	Hongkong & China, Limited	13–14	..	4 5 8
3,800,000	Stck.	14 Nov.	12	Imperial Continental	248–253	–2	4 14 10
376,400	100	1 Feb.	4	Do. 4 p. c. Debs. Red.	100–103	..	3 17 8
473,600	Stck.	13 Feb.	3½	Do. 3½ p. c. Deb. Stk ,,	108–110	..	3 3 8

Issue.	Share.	When ex-Dividend.	Dividend or Dividend & Bonus.	NAME.	Closing Prices.	Rise or Fall in Wk.	Yield upon Investment.
£			p. c.	GAS COMPANIES.			£ s. d.
75,000	5	16 Dec.	6	Malta & Mediterranean, Ltd.	6–6½	..	4 12 4
560,000	100	1 Oct.	5	Met. of Melbourne, 5 p. c. Deb.	115–118	..	4 4 10
250,000	100	,,	4½	Do. 4½ p. c. Debs.	109–111	..	4 1 1
541,920	20	14 Nov.	5	Monte Video, Limited	16½–17½	..	5 14 3
150,000	5	28 Nov.	8	Oriental, Limited	8⅛–8⅜	..	4 11 5
135,000	5	,,	8	Do. New, £4 10s. paid	7¾–7¾	+⅛	4 12 10
15,000	5	,,	8	Do. do. 1879, £1 paid	1¾–2	..	4 0 0
60,000	5	12 Mar.	7	Ottoman, Limited	4⅜–5⅛†	..	6 13 4
166,870	10	14 Feb.	2	Para, Limited	1⅛–1⅜	..	11 8 6
420,000	100	2 Nov.	6	People's Gas } 1st Mtg. Bds.	105–110	..	5 9 1
500,000	100	9 Dec.	6	of Chicago } 2nd Do.	100–105	..	5 14 3
250,000	10	16 Oct.	7	San Paulo, Limited	12½–13½	+⅛	5 3 9
500,000	Stck.	13 Feb.	15½	South Metropolitan, A Stock	385–390	+3	3 19 9
1,350,000	,,	,,	12	Do. B do.	310–315	+1	3 16 2
310,000	,,	,,	13	Do. C do.	327–332	+2	3 18 3
800,000	,,	16 Jan.	5	Do. 5 p. c. Deb. Stk.	175–178	..	2 16 2
60,000	Stck.	12 Mar.	11½	Tottenham & Edmonton, A	250–255†	+5⅛	4 10 2
60,000	,,	,,	8½	Do. B	—	..	—
170,380	10	30 Dec.	10	Tuscan, Limited.	13–14	..	7 2 10
149,900	10	2 Jan.	5	Do. 5 p. c. Debs. Red.	100–102	..	4 18 0

WATER COMPANIES.

746,021	Stck.	30 Dec.	10½	Chelsea, Ordinary	320–325	+8	3 3 1
150,000	,,	,,	5	Do. 5 p. c. Pref.	170–175	+2	2 17 1
160,000	,,	,,	4½	Do. 4½ p. c. Pref. Stk., 1875	—	..	—
175,785	,,	27 Sept.	4½	Do. 4½ p. c. Deb. Stock	155–160	..	2 16 3
1,719,514	Stck.	16 Oct.	7	East London, Ordinary	253–258	..	2 14 1
654,740	,,	30 Dec.	4½	Do. 4½ p. c. Deb. Stk.	155–160	..	2 16 3
100,000	,,	,,	3	Do. 3 p. c. Deb. Stk.	105–107	..	2 16 1
700,000	50	16 Dec.	6½	Grand Junction, 10 p.c. max.	125–129	..	2 10 4
280,000	Stck.	27 Sept.	4	Do. 4 p. c. Deb. Stk.	145–150	..	2 13 4
708,000	Stck.	13 Feb.	12	Kent	332–337	..	3 11 2
160,000	,,	,,	7	Do. New, 7 p. c. max.	205–210	..	3 6 8
1,043,800	100	30 Dec.	7¼	Lambeth, 10 p. c. max.	272–277	+2	2 12 4
406,200	100	,,	7¼	Do. 7¼ p. c. max.	223–228	+3	3 3 7
330,000	Stck.	27 Sept.	4	Do. 4 p. c. Deb. Stk.	147–152	..	2 12 8
500,000	100	13 Feb.	12¾	New River, New Shares	420–430	+5	2 19 3
1,000,000	Stck.	30 Jan.	4	Do. 4 p. c. Deb. Stk.	152–157	..	2 10 11
902,300	Stck.	16 Dec.	6	S'thwk & V'xhall, Ordinary	172–177	..	3 7 10
126,500	100	,,	6	Do. Do. 7½ p. c. Max.	153–165	..	3 12 9
489,200	Stck.	,,	5	Do. Do. 5 p. c. Pref.	168–173	..	2 17 9
1,019,585	,,	—	4	Do. 4 p. c. A Deb. Stk.	147–152	..	2 12 8
1,155,066	Stck.	16 Dec.	10	West Middlesex	305–310	..	3 4 6
200,000	,,	,,	4½	Do. 4½ p. c. Deb. Stk.	155–160	..	2 16 3

*Ex div.

The Water Supply of Kingsteignton.—An estimate of the cost of carrying out the proposed works for the supply of water to Kingsteignton was laid before the Newton Abbot District Council last Tuesday. Mr. Segar, the Surveyor, put the amount at £2000 or £2100, including a tank at Holywell, and a main thence to the town. In addition, there would be some claim for compensation. It was decided to apply for a loan of £2500.

Extensions at the Mansfield Gas-Works.—Some important extension works are about to be carried out at the gas-works of the Mansfield Corporation, from the plans and designs of the Engineer and Manager (Mr. A. Graham). A retort-stack on the regenerative system is to be erected by Messrs. Jonas Drake and Son, of Halifax; a new wrought-iron retort-house roof will be supplied by Messrs. R. & J. Dempster, of Manchester; and the alterations to the retort-house buildings have been entrusted to Mr. John Greenwood, of Mansfield.

Extension of the Pumping Plant at the York Water-Works.—The York Water Company have recently decided to augment the pumping power at their works at Acomb Landing, to enable them to meet the increasing demands of the consumers. With this view, Messrs. J. Simpson and Co., Limited, of Pimlico, have been instructed to build a large compound horizontal pumping-engine, capable of lifting 3½ million gallons per day against a head of about 200 feet, and to put down three Lancashire boilers, 7 ft. 6 in. diameter, to work with a boiler pressure of 100 lbs. on the square inch, together with other necessary plant. The engine will be arranged with cranks at right angles, with a steam-jacketed receiver between the cylinders; and the pumps will draw their water from a clear-water well about 170 yards from the engine-house, and will discharge into the present 21-inch main. The contract for all the piping required in connection with the extension has also been placed in the hands of the above-named firm. The whole of the work will be carried out under the supervision of Mr. W. H. Barbey, the Company's Superintendent Engineer.

The Price of Gas at Deal and Walmer.—At the last meeting of the Deal Town Council, the Gas Committee presented a report in respect of the negotiations which had taken place with the Deal and Walmer Gas Company as to the price and quality of the gas. The Secretary of the Company (Mr. W. R. Hammond) had replied that the Directors would be pleased to meet the Committee to discuss the affairs of the Company in a general way; but they might at once state that no reduction could be made in the present price of 3s. 10d. per 1000 cubic feet until the Company were relieved from some of the heavy charges they are now liable for, or their position was in other respects improved. A discussion ensued, in which a suggestion was thrown out that the Directors should adopt some more modern system of public lighting. The Mayor (Alderman Hayman) thought the Company might be approached on this question. It was, however, decided to let the matter rest till the expiration of the present lighting contract. In the meantime, a numerously signed petition has been sent to the Company by private consumers, praying for a reduction in price.

Reduction in Price.—The Directors of the Tonbridge Gas Company have resolved to reduce the price of gas from 3s. 4d. to 3s. 2d. per 1000 cubic feet from the 31st inst.

The Consumption of Gas at Redcar.—At the recent annual meeting of the Redcar Gas Company, the Chairman (Mr. J. Rutherford, J.P.) remarked that, though the Directors were gratified to report an increased consumption of gas during the past year, they confessed to a little disappointment that the reduction in price last July had not resulted in such an augmented consumption as they were led to expect. Though the credit balance for the year was less than for 1894 by £413, they had resolved to recommend that the dividend should be the same as before, and that the surplus of £393 should be carried forward to the next account. The report was adopted. Votes of thanks were passed to the Directors, and a similar compliment was paid to Mr. M. Fligg, the Secretary of the Company.

The Water Supply of East Looe.—An inquiry was held at Looe, Cornwall, on the 3rd inst., by Mr. L. A. Selby Bigge, an Assistant-Commissioner under the Charitable Trusts Act, with reference to a proposed loan for the improvement of the water-works belonging to the East Looe Town Charity. The question of improving the water supply has been under consideration ever since the scheme for the Trust was formed in 1890. At the time there was a probability of a Company being started to take over the works and discharge the liabilities of the Trust. But the expectation has not been fulfilled; and the income from the water-works has been absorbed in the payment of the interest on a debt incurred by the ancient, and now extinct, Corporation in the building of a town hall. There are therefore no funds available for extending and improving the water-works, though this is greatly needed. The Trustees propose to construct an enlarged reservoir so as to avoid pollution and increase the pressure. Mr. Selby Bigge said the Charity Commissioners would not allow the Trustees to incur fresh liabilities unless provision were made for a sinking fund. In the course of conversation, it was stated that a Company buying the works and providing for the extension would probably make a very good thing out of it, and earn a dividend of 3½ to 4 per cent. from the beginning. The alternative was to hand over the works to the District Council. But the Trustees are opposed to this; and one of the leading ratepayers said he knew that body and their ways, and dreaded the increased burden that would be thrown upon the ratepayers if the course were adopted. On the other hand, it was said that many people now used the water and did not pay for it, and that while the Trustees could not compel people to take the water, the District Council would have this power; and any addition to the rates would not be very serious. Another suggestion was that, if a sale of the works were sanctioned, the Charity Commissioners should insert a redemption clause, enabling the Trustees to re-purchase within a given time. Mr. Selby Bigge asked to be supplied with details of the prospective increase of revenue; and he promised, if his request were granted, to withhold his report until he received them.

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401	18½	13½	11½	14	11	9½	13½ by 11½	1	28/6	—
402	24½	15½	15	18	11	11	15½ ,, 15	2	40/-	2/6
403	30	18	17	19	11	11	18 ,, 17	2	45/-	2/6
404	30	18	17	19	13½	11	18 ,, 17	2	50/-	2/6
404	If fitted with Enamelled-Lined and Jacketted Door and Fire-Brick Crown, as adopted by The London Gaslight and Coke Co.								55/-	2/6

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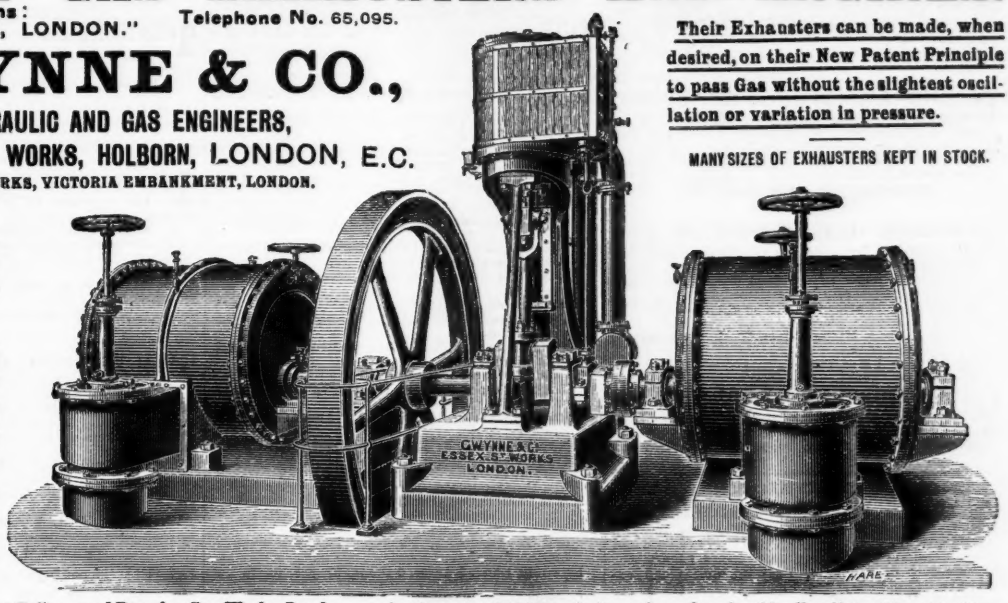

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Any other Particulars may be obtained on application to the Manager, Mr. J. NICHOLSON.

ON SALE, for immediate removal—
One GASHOLDER, 40 feet diameter, 14 feet deep, with Columns and Girders complete.
One GASHOLDER, 30½ feet diameter, 11 feet deep with Columns and Girders complete.
Also a quantity of RETORT-FITTINGS, including MOUTHPIECES, LIDS, ASCENSION-PIPES, H-PIPES, and HYDRAULIC MAINS.
For further Particulars, apply to G. E. SAVILLE, Engineer, Gas-Works, TODMORDEN.

WIDNES CORPORATION GAS AND WATER WORKS.

GAS PLANT, &c., FOR SALE.

THE Gas and Water Committee have the following PLANT for disposal: ANNULAR CONDENSER, ENGINE and EXHAUSTER (capacity, 22,000 Cubic Feet per hour), MANN and WALKER TOWER SCRUBBER, 38 ft. by 8 ft., and a WALKER PURIFYING-MACHINE of 1 Million Cubic Feet capacity per diem.
Further Particulars may be obtained on application to Mr. ISAAC CARR, Assoc.M.Inst.C.E., Gas-Works, WIDNES.

GAS PLANT, BUILDINGS,
AND
FREEHOLD LAND AT CARSHALTON, SURREY, FOR IMMEDIATE SALE.

THE Croydon Commercial Gas and Coke Company, having discontinued the Manufacture of Gas at their Works in Wrythe Lane, Carshalton, Surrey, have the following GAS PLANT, APPARATUS, BUILDINGS, and FREEHOLD LAND FOR SALE, viz.—
Retort-House and Coal-Store complete, with Wrought-Iron Roofs, six Beds of six Round Fire-Clay Retorts in each, 18 inches diameter by 9 ft. 3 in. long, and three Beds of similar new Retorts and Arches, and three Arches, complete, ready for Retorts.
Hydraulic Mains, Fittings, &c.
Horizontal Steam-Engine, Exhauster, and Exhauster Governor, complete.
Washer (Good's Patent), 8 feet diameter, with 12-inch Connections and Valves complete.
Washer, 12-inch, with 6-inch Connections and Valves complete.
Four Purifiers, 12 feet square, with Sieves and 12-inch Connections, Lifting Apparatus and Railway for same, complete.
Station Meter, 10,000 cubic feet per hour, with 12-inch Connections.
Gasholder (Single-Lift), 80 feet by 24 feet, with Brick Tank, Columns, Inlet and Outlet Valves complete, prepared for Telescoping.
Gasholder (Single-Lift), 60 feet by 16 feet, Standards, Brick Tank, &c.
Gasholder, 35 feet by 12 feet, Standards, Brick Tank, &c.
Governor, 12 inches diameter, with 12-inch Valves and Bye-Pass complete.
Evans Photometer, Clock, Gauges, &c., complete.
House and Offices, Engine and Boiler House, Meter-House, Lobby and Store-Room, Governor-House and Testing-Room, Purifying House and Shed, Smith's Shop.
Freehold Land, 3 acres, 0 roods, 37 perches (about 2 acres not built upon).
Orders to view the Plant and Works, and Particulars of Prices the Company require for the whole or any portion of the above, can be obtained on application to
W. J. RUSSELL,
Secretary.
Offices: Katharine Street, Croydon,
March, 1896.

SHEFFIELD UNITED GASLIGHT COMPANY.

TO STEEL JOIST MANUFACTURERS, GIRDER CONTRACTORS, &c.

THE Directors of this Company invite TENDERS for the supply and erection of STEEL PLATE GIRDERS and ROLLED JOISTS to form Upper Floor for Purifying-House and Floors in Liquor Tower at their Grimesthorpe Station.
The Floor is 225 feet long by 91 feet wide.
Drawings may be seen, and Specification with Bill of Quantities and Form of Tender obtained, on application to the Engineer, Mr. Fletcher W. Stevenson, on payment of 10s. 6d., which will be returned on receipt of *bonâ-fide* tender.
Sealed tenders, endorsed "Tender for Steel Girder Floor," must be delivered by post to the undersigned at the Company's Offices not later than first post on Monday, the 30th inst.
The Directors do not bind themselves to accept the lowest or any tender.
HANBURY THOMAS,
General Manager.
Commercial Street, Sheffield,
March 10, 1896.

SHEFFIELD UNITED GASLIGHT COMPANY.

TO ENGINEERS, IRONFOUNDERS, &c.

THE Directors of this Company invite TENDERS for the supply and erection of CAST-IRON COLUMNS and GIRDERS to form Floor to carry Purifiers, together wth CAST-IRON LIQUOR TANK and GIRDERS to carry the same, at their Grimesthorpe Station.
The Purifier-Floor is 225 feet long by 91 feet wide; and the Liquor Tank, 33 feet long by 25 feet wide.
Drawings may be seen, and Specification with Bill of Quantities obtained, on application to Mr. Fletcher W. Stevenson, on payment of 10s. 6d., which will be returned on receipt of *bonâ-fide* tender.
Sealed tenders, endorsed "Tender for Purifier Floor and Tank," must be delivered to the undersigned at the Company's Offices (by post) not later than the first post on Monday, the 30th inst.
The Directors do not bind themselves to accept the lowest or any tender.
HANBURY THOMAS,
General Manager.
Commercial Street, Sheffield,
March 9, 1896.

SHEFFIELD UNITED GASLIGHT COMPANY.

TO IRON ROOF AND GIRDER CONTRACTORS.

THE Directors of this Company invite TENDERS for the supply and erection of an IRON ROOF, together with GIRDERS and COLUMNS to carry the same, for a Purifying-House at their Grimesthorpe Station.
The Roof is 225 feet long by 91 feet wide.
Drawings may be seen, and Specification with Bill of Quantities and Form of Tender obtained, on application to the Engineer, Mr. Fletcher W. Stevenson, on payment of 10s. 6d., which will be returned on receipt of *bonâ-fide* tender.
Sealed tenders, endorsed "Tender for Iron Roof," must be delivered to the undersigned at the Company's Offices (by post) not later than the first post on Monday, the 30th inst.
The Directors do not bind themselves to accept the lowest or any tender.
HANBURY THOMAS,
General Manager.
Commercial Street, Sheffield,
March 10, 1896.

MACCLESFIELD CORPORATION.
(GAS DEPARTMENT.)

TO MAINLAYERS.

TENDERS are invited for the Labour required in the LAYING of 1000 yards of 12-inch MAINS.
Particulars on application to
J. G. NEWBIGGING,
Engineer.

RAMSGATE CORPORATION.
(WATER DEPARTMENT.)

TWO New Steel Boilers, 30 ft. by 7 ft. 6 in. are required, to be delivered by the end of August.
Specification and full Particulars will be furnished on application, accompanied by a deposit of Two Guineas (£2 2*s.*), which will be returned on receipt of a *bonâ-fide* tender.
Tenders must be sent in on or before Monday, March 23.
WILLIAM A. M'INTOSH VALON,
Engineer.

THE Westerham Gas and Coke Com-pany, Limited, invite TENDERS for the Supply and Setting of a BED of FIVE BEST STOURBRIDGE FIRE-CLAY RETORTS, with the necessary Bricks, Fire-Clay, &c.
Specifications may be had on application to the undersigned.
Endorsed tenders to be sent in by the 1st of April.
By order,
CHAS. HOOKER,
Secretary and Manager.
Westerham, Kent.

MIRFIELD GAS COMPANY.

THE Directors are open to receive TENDERS for the AMMONIACAL LIQUOR and surplus TAR, either together or separately, for Twelve Months from the 1st of April next.
Tar at the Works per ton, and Ammoniacal Liquor f.o.b., at per oz. strength, by Wills's Test.
Tenders, endorsed "Tar" or "Ammoniacal Liquor," not later than Monday, the 30th of March inst., addressed to
SAMUEL DAY,
Secretary.
Gas Company's Office, Ravensthorpe,
March 12, 1896.

SKIPTON GAS COMPANY.

THE Directors of this Company are pre-pared to receive TENDERS for the supply of 6000 Tons of good GAS COAL, to be delivered in such quantities and at such times as may be required during Twelve Months ending June 30, 1897.
Quotations to specify if Coal is screened or unscreened, and price delivered, free on rail, at Skipton Station, or free on Boat alongside the Company's Works.
Sealed tenders, endorsed "Tender for Coal," to be sent to the undersigned not later than April 6 next.
The Directors do not bind themselves to accept the lowest or any tender.
J. HAIGH,
Secretary.
Gas Office, Skipton,
March 13, 1896.

EDINBURGH AND LEITH CORPORATIONS GAS.

THE Commissioners invite Tenders to supply COALS, LIME, and GENERAL STORES (PIPES, PAINT, TIMBER, &c.) required at their Works in Edinburgh and Leith during the Year from Whitsunday next.
The Contractors must guarantee that in the execution of their contracts they will pay the Standard recognized Rate of Wages, or such Wages as are generally accepted as fair in the Trade.
Tender Forms and all Information can be had on application to the Engineers at either of these Works.
Offers must be lodged not later than Ten o'clock on Tuesday forenoon, the 24th curt., in sealed envelopes, addressed to the undersigned, and marked "Tender for Coal" (or as the case may be).
The Commissioners are not to be bound to accept the lowest or any tender.
JAMES M'G. JACK,
Clerk.
25, Waterloo Place, Edinburgh,
March 13, 1896.

WALLASEY URBAN DISTRICT COUNCIL.

GAS-WORKS EXTENSION.

TO ENGINEERS AND MAKERS OF GAS PLANT.

THE Wallasey Urban District Council are prepared to receive TENDERS for—
(*a*) Four-Wheel Coupled LOCOMOTIVE.
(*b*) STATION METER.
Copies of the Specifications may be obtained on application to the Engineer, Mr. J. H. Crowther, at the Gas and Water Works, Great Float, near Birkenhead. A charge of £2 2*s.* will be made for copy of each Specification, to be returned on receipt of a *bonâ-fide* tender.
Sealed tenders on the form provided for the purpose, addressed to the Chairman of the Gas and Water Committee, and endorsed "Tender for Locomotive," or "Station Meter," as the case may be, to be delivered at my Office, as below, not later than Four o'clock in the afternoon on Monday, the 6th day of April, 1896. Each Contractor will be required to enter into a bond with approved Sureties for the due performance of the Contract.
The Council do not bind themselves to accept the lowest or any tender.
By order,
W. DANGER,
Clerk to the Council.
Public Offices, Egremont, Cheshire,
March 6, 1896.

TENDERS FOR TAR.

THE Directors of the Exeter Gaslight and Coke Company invite TENDERS for their surplus TAR, for One Year from Lady-day next.

Delivery on Company's Works filled into Purchaser's Tanks.

Sealed tenders, endorsed "Tender for Tar," will be received by the undersigned on or before Wednesday, the 25th day of March next; but the Directors do not bind themselves to accept the highest or any tender.

By order,
W. A. PADFIELD,
Engineer and Secretary.

Gas Offices: 248, High Street, Exeter,
March 2, 1896.

RAMSBOTTOM GAS COMPANY.

TENDERS FOR GAS COAL.

THE Directors of the Ramsbottom Gas Company invite TENDERS for the supply of GAS COAL.

Specifications and Form of Tender may be obtained on application to the undersigned.

Tenders to be sent in, addressed to the Chairman of the Company, and endorsed "Tender for Coal," on or before Friday, April 3, 1896.

JOS. C. INGHAM,
Manager.

Gas-Works, Stubbins, Ramsbottom.

BOROUGH OF DEWSBURY.

THE Gas Committee invite Tenders for the supply of RETORTS, FIRE BRICKS, &c.

Particulars of Quantities and Forms of Tender may be obtained from Mr. Chas. A. Craven, Engineer and Manager, Savile Town Gas-Works, Dewsbury.

The Contractors will be required to give an assurance that they will pay to the efficient and capable workmen employed by them not less than the minimum Standard Rate of Wages in each branch of the Trade.

Sealed tenders, endorsed "Tender for Retorts," to be sent to me the undersigned not later than Monday, the 23rd inst.

The Corporation do not bind themselves to accept the lowest or any tender.

By order,
G. TREVELYAN LEE,
Town Clerk.

Town Clerk's Office, Town Hall, Dewsbury,
March 14, 1896.

URBAN DISTRICT COUNCIL OF DUKINFIELD.

TENDERS FOR GAS COAL.

THE Gas Committee require Tenders for Seven Thousand Five Hundred Tons of GAS COAL, to be delivered by Road, Rail, or Canal, commencing on the 1st of May next, and concluding the 30th of June, 1897. Of this quantity, 3500 Tons will be received before the 15th of August next for Stock. None but fresh-got screened best quality GAS COAL free from fault need be offered; and no Testimonials or Analyses are required.

No Tender will be considered which may be received after Twelve at noon on Wednesday, the 25th of March.

Sealed envelopes, endorsed "Coal," to be directed to the Chairman of the Committee, Mr. Councillor Halstead, Gas Offices, Charles Street, Dukinfield.

Tender Forms and further Particulars on application to

HARRISON VEEVERS, C.E.,
Engineer and Secretary.

Dukinfield, Feb. 27, 1896.

KNUTSFORD LIGHT AND WATER COMPANY.

THE Directors invite Tenders and full Particulars and Prices for OBTAINING and LIFTING from 250,000 to 350,000 gallons of WATER per day of 24 hours. These new Works are to be placed at Booth Mills, one mile from Knutsford Station; and the Works must include all Appliances for lifting the Water to the level of the ground, and, if necessary, to a Tank 140 feet above the level of the ground at Booth Mills, through an 8-inch Main, three-quarters of a mile long. The Price must include for Boring and obtaining Water underground.

A full description of the Works and the Linings of the Borehole, with Prices and the extent of time required for the execution of the Works, to be sent to the Chairman of the Company, W. Nicholls, Esq., King Street, Knutsford.

For further Information, apply to the Secretary of the Company.

Tenders to be sent in not later than the 24th inst.

The Directors do not bind themselves to accept the lowest or any tender.

COUNTY BOROUGH OF HALIFAX.

TO MANUFACTURING CHEMISTS AND TAR DISTILLERS.

THE Gas-Works Committee of the Halifax Corporation are prepared to receive TENDERS for the purchase of the surplus TAR produced at their Gas-Works for One, Two, or Three Years from the 30th of June, 1896; the quantity of Tar produced being about 4000 Tons annually. Delivery must take place from the Railway Siding of the Corporation Gas-Works, or from the Canal Wharf of the Calder and Hebble Navigation, with which a pipe communicates.

Full Particulars may be obtained on application to the Engineer, Mr. Thomas Holgate, F.C.S., Gas-Works, Halifax.

Sealed tenders, endorsed "Tar," stating the price offered per ton, and the mode of removal, to be sent to the undersigned not later than Ten a.m., on Wednesday, the 25th of March, 1896.

The highest or any tender will not necessarily be accepted.

By order,
KEIGHLEY WALTON,
Town Clerk.

Town Hall, Halifax,
March 12, 1896.

ISSUE OF STOCKS AND SHARES BY AUCTION UNDER PARLIAMENTARY POWERS.

MR. ALFRED RICHARDS undertakes the issuing by Auction of GAS AND WATER SHARES under Parliamentary Powers.

He also holds MONTHLY SALES of GAS AND WATER SHARES at the Auction Mart, Tokenhouse Yard, E.C.

Terms for the issuing of Capital, and also for offering to auction Gas and Water Shares, and all Particulars relating thereto, may be had of Mr. Alfred Richards.

Offices: 18, FINSBURY CIRCUS, E.C.

Second Portion of the Estate of the late William Halfhead, Esq.—Important Sale of Gas and Water Stocks and Shares.

Gaslight and Coke Company—£450 Stock ("A" and "K").
Commercial Gas Company—£520 Stock (Old and New, and Debenture).
Hornsey Gas Company—£1220 Stock ("C," "B," and Preference).
West Ham Gas Company—237 Shares and £700 Debenture Stock.
Tottenham and Edmonton Gas Company—£460 Stock ("A" and "B").
Lea Bridge Gas Company—15 Shares (Original).
Romford Gas Company—47 Shares (Original and "B").
West Kent Gas Company—44 Shares (Original and New).
Worthing Gas Company—£200 Stock and 10 New Shares.
Enfield Gas Company—£731 Stock (Preference and Debenture).
North Camp and Farnborough Gas Company—20 Shares.
Bournemouth Gas and Water Company—40 "B" Shares, £300 Debenture Bonds.
Barnet District Gas and Water Company—£120 Stock, 20 "D" Shares.
West Surrey Water Company—152 Ordinary and Preference Shares and £450 Debenture Stock.

All paying good Dividends and offering Investments of the highest character.

MR. ALFRED RICHARDS will Sell the above BY AUCTION, at the Mart, E.C., on Wednesday, March 18, at Two o'clock precisely, in lots.

Particulars of Messrs. LEWIS AND SONS, Solicitors, 7, WILMINGTON SQUARE, W.C., and of the AUCTIONEER, 18, FINSBURY CIRCUS, E.C., and TOTTENHAM.

HARROW AND STANMORE GAS COMPANY.

NOTICE is Hereby Given, that the Directors of the above Company intend to offer for SALE by PUBLIC AUCTION, at the Mart, Tokenhouse Yard, in the City of London, on Monday, the 27th day of April next, at Two o'clock in the afternoon precisely, £5000 of New "C" Capital, in Shares of £10 each, in Lots of ten Shares each, to be issued under the Powers of the Harrow and Stanmore Gas Act, 1894.

By order,
JAMES LAWRENCE CHAPMAN,
Secretary.

Dated this 12th day of March, 1896.

SOUTHEND GAS COMPANY.

NOTICE is Hereby Given, that the ANNUAL ORDINARY GENERAL MEETING of the Proprietors in this Company will be held at the Company's Offices, No. 52, High Street, Southend, Essex, on Monday, the 23rd of March inst., at Two o'clock precisely, to receive the Report of the Directors and the Statement of Accounts for the Half Year ended the 31st of December, 1895, to declare Dividend, to elect two Directors and one Auditor retiring by rotation, to consider notice of motion for increasing the Auditors' Fee, and to transact such other Business as the Act of Parliament directs.

The TRANSFER BOOKS WILL BE CLOSED from the 9th until the 25th inst., both days inclusive.

By order of the Board,
JAS. T. RANDALL,
Secretary.

Offices of the Company:
52, High Street, Southend-on-Sea,
March 3, 1896.

NOTICE TO CREDITORS AND CLAIMANTS.

CLONMEL GAS CONSUMERS' COMPANY, LIMITED.

IN LIQUIDATION.

NOTICE is Hereby Given that, by Special Resolution of the said Company, passed at an Extraordinary General Meeting, duly convened and held on the 13th day of February, 1896, and confirmed at a further Extraordinary General Meeting, duly convened and held on the 12th day of March, 1896, it was resolved—

"That this Company be dissolved, and that Benjamin Fayle, Esq., J.P., Chairman, and Robert Malcomson, Esq., and Michael Ryan, Esq., J.P., Directors of the Company, be appointed Liquidators, with power to arrange for such assistance as they may deem necessary."

All persons claiming to be Creditors of, or having any claim or demand whatsoever on, the above-named Company, and all persons (if any) other than the Registered Shareholders holding any Shares or Share Certificates, or claiming any lien or other claim whatsoever on any Shares or Share Certificates of or in the said Company, are hereby required, on or before Saturday, the 11th day of April, 1896, to SEND THEIR NAMES and ADDRESSES, and the PARTICULARS of their DEBTS and CLAIMS, in writing, to the said Liquidators at the new Offices of the said Company, Literary Institute, Clonmel.

And Notice is Hereby Given, that the said Liquidators will, immediately after said date, proceed to DISTRIBUTE THE ASSETS of said Company, according to the Company's Deeds of Settlement, having regard only to such Debts or Claims as they shall then have notice of.

Dated this 12th day of March, 1896.

T. W. HARDMAN & SONS,
Solicitors for said Liquidators.

14, Molesworth Street, Dublin.

BRITISH GASLIGHT COMPANY, LIMITED.

NOTICE is Hereby Given, that the HALF-YEARLY ORDINARY GENERAL MEETING of the Proprietors of this Company will be held at this Office, on Wednesday, the 25th inst., at half-past Twelve o'clock precisely, to transact the usual Business, and to declare the Dividend for the Half Year ended the 31st of December last.

Notice is Hereby also Given, that the TRANSFER BOOKS of the Company WILL BE CLOSED on the 14th and RE-OPENED on the 26th inst.

By order of the Court of Directors,
FREDERIC LANE LINGING,
Secretary.

Chief Office: No. 11, George Yard,
Lombard Street, London, E.C.,
March 6, 1896.

Price 6s., Cloth Bound,

THE CHEMISTRY OF ILLUMINATING GAS.

By N. H. HUMPHRYS, Assoc. M.Inst.C.E., F.C.S.

This work contains chapters on: The Relative Cost of Light from Gas, Oil, and Candles; Products of Combustion; The Sulphur Question; The Composition of Illuminating Gas; Water Gas; Various Gas-Making Processes; Oil Gas; Properties of Fluid Hydrocarbons; Tar for Gas-Making; Destructive Distillation; Condensation; and Purification.

WALTER KING, 11, Bolt Court, FLEET STREET, E.C.

JAMES OAKES & Co.,

ALFRETON IRON-WORKS, DERBYSHIRE,
AND
Wenlock Iron Wharf, 21 & 22, Wharf Road, CITY ROAD, LONDON, N.,

Manufacture and keep in Stock at their Works (also large stock in London)

PIPES and CONNECTIONS, 1¼ to 48 inches in diameter, and make and erect to order RETORTS, PURIFIERS and TANKS, with or without planed joints, COLUMNS, GIRDERS, SPECIAL CASTINGS, &c., required by Gas, Water, Railway, Telegraph, Chemical, Colliery, and other Companies.

NOTE.—Makers of HORSLEY'S PATENT SYPHONS. These are cast in one piece, without Chaplets; doing away with bolts, nuts and covers, and rendering leakage impossible.

HOLMSIDE GAS COALS.

PRESENT DAILY PRODUCE OVER 4000 TONS.

LATEST ANALYSIS—By CHARLES PHILLIPS, Gas Examiner to Rotherham Corporation.

Yield of Gas Per Ton. . 11,205 Cubic Feet.
Illuminating Power, 16 7/8 Stand. Sperm. Candl.
Coke (of good & pure quality) 13¾ Cwt. Per Ton.
Sulphur . . . . A little over 1 Per Cent.
Ash . . . . . Under 1 Per Cent.
Tar . . . . . 163 Lbs. (Avoir.) Per Ton.
Ammoniacal Liquor 103 Lbs. (Avoir.) Per Ton.

HOLMSIDE GAS COALS are supplied to the largest Gas Companies in England and on the European Continent; London alone consuming about half the produce.

SOUTH MOOR PELTON GAS COALS.

PRESENT DAILY PRODUCE AVAILABLE 2500 TONS.

RESULTS OF DIFFERENT ANALYSES:—

Yield of Gas Per Ton. . 10,500 Cubic Feet.
Illuminating Power . 17 Stand. Sperm Candl.
Coke (of excellent quality) . 13½ Cwt. Per Ton.
Sulphur . . . . . 1·13 Per Cent.
Ash. . . . . 1·34 Per Cent.
Tar. . . . . 180 Lbs. (Avoir.) Per Ton.
Ammoniacal Liquor 94½ Lbs. (Avoir.) Per Ton.

The HOLMSIDE and SOUTH MOOR COAL-FIELD possesses *a very great quantity of the best Coal;* and, whilst other Coal-Fields are becoming exhausted, this one is only being opened out, so that *the quality* of both the HOLMSIDE COALS, and the SOUTH MOOR COALS *may be relied upon for all practical purposes.*

These Coals may be bought through the Principal Merchants in England, or direct from

MR. MARK ARCHER,
HOLMSIDE AND SOUTH MOOR OFFICES,
NEWCASTLE-UPON-TYNE.

The SUBSCRIPTION LIST OPENED MONDAY, the 16th inst., and will be CLOSED on or before THURSDAY, the 19th inst.

A Contract has already been secured by the Vendor for the Company, which should provide a Dividend at the rate of 8 per cent. per annum on the Ordinary Shares after payment of the Preferential Dividend of 7 per cent. on the Preference Shares.

THE Cottonwood Water Power & Electric Company, Limited.

INCORPORATED UNDER THE COMPANIES ACTS, 1862 TO 1893.

CAPITAL - - - - £210,000.

Divided into—105,000 7 per cent. Preference Shares of £1 each . . . £105,000
And 105,000 Ordinary Shares of £1 each . . . . . £105,000——£210,000

ISSUE of 70,000 SEVEN PER CENT. PREFERENCE SHARES of £1 each, and 70,000 ORDINARY SHARES of £1 each. The balance of the Preference and Ordinary Shares will be allotted to the Vendor in part payment of the Purchase Money. Payable as follows: 5s. per Share on Application, 5s. per Share on Allotment, and the Balance in calls not exceeding 5s. per Share, at intervals of not less than two months.

The Preference Shares will be entitled in each year to a Preferential Dividend at the rate of 7 per cent. per annum; the balance of the net profits in each year will belong to the Ordinary Shares; and in any year in which a Dividend of 14 per cent. per annum has been paid on the Ordinary Shares, the balance of net revenue will be divided equally between the Preferred and Ordinary Shareholders.

Interest at the rate of 6 per cent. per annum on instalments received will be paid by the Contractor on both classes of Shares for the first Six Months from the 25th of March next, after which it is expected the Company's Plant will be in active operation.

DIRECTORS.

JOHN BOUSTEAD, Esq., Director Lambeth Water-Works Company (Chairman).
R. A. FAIRCLOUGH, Esq., Director Cape Town and District Gaslight and Coke Company, Limited.
H. R. SAVORY, Esq., Director Salt Lake and Ogden Gas and Electric Light Company, Limited.
F. WILLIAMS, Esq., Elm Villa, Kingston-on-Thames.
Colonel A. J. FILGATE, Chairman Hove Electric Lighting Company, Limited.

LOCAL BOARD.

R. F. HAYWARD, Esq., Electrical Engineer, Salt Lake City.
FRANK K. GILLESPIE, Esq., Ex-Secretary Chamber of Commerce, Salt Lake City.

BANKERS: The NATIONAL PROVINCIAL BANK of ENGLAND Limited, 112, Bishopsgate Street, E.C., and Branches.

BROKERS: Messrs. D. L. THOMSON AND CO., 7, Drapers' Gardens, Throgmorton Street, E.C.

SOLICITORS: Messrs. WAINWRIGHT, POLLOCK, AND CO., 42, Bishopsgate Street Within, E.C.

AUDITORS: Messrs. DELOITTE, DEVER, GRIFFITHS, AND CO.

CONSULTING ENGINEER: J. S. RAWORTH, Esq., Manager Brush Electric Engineering Company.

SECRETARY AND OFFICES: E. A. KING, 297, Winchester House, E.C.

PROSPECTUS.

This Company has been formed for the purpose of acquiring the Waters, Water Falls, Reservoir Sites, and Lands necessary for the operations of the Company of and in the Little Cottonwood Creek, situated near Salt Lake City, Utah, U.S.A., and of erecting a water-power plant for the supply of electrical current.

Electricity has made more rapid progress, and is in more general use in America than in England. There is scarcely any city or town that has not its electric plant for lighting and other purposes. The economy of water power is an important element of its success, and has proved most profitable to those fortunate enough to possess it. Electrical companies, both in America and England, are endeavouring to find sources of water supply for generating electric current.

This Company occupies an unique position in having secured the water power of Little Cottonwood Creek. The water power being perpetual, even during the driest summer months, and the demand for electric power all the year round being largely in excess of what this Company can supply, there appears to be no doubt of the enterprise proving a most profitable one for the investor.

There are many towns and cities in the United States that are now supplied with electric current by water power; and the experience thus gained has fully demonstrated that electrical transmission, having water power as its initiative, far exceeds all other developments of electrical science in profitable working.

The Little Cottonwood Creek has its source in lakes fed by perpetual springs near the summit of the Wasatch Range of the Rocky Mountains, near Salt Lake City. The altitude of these lakes is from 10,000 to 11,500 feet above sea-level; and the descent of the creek to the mouth of the Canon, about eight miles, is 3200 feet, or an average of 400 feet to the mile. The volume of water, at the lowest stage known, is over 28 cubic feet per second; and, if required, there can be obtained, by the multiple use of the water, at least 5000 saleable horse power.

The Pioneer Power House will be located near the mouth of the Canon; and by the operation of a series of Pelton water-wheels attached to electric dynamos, the electric current will be generated, and then conveyed by wires to the several places where power may be required. The construction of the Pioneer Power Plant will be designed for 2000-horse power, and will be so arranged that additions can be made at small cost from time to time. It is well known that, after the first installation of water power, the expense of its maintenance is reduced to the small item of supervision. The cost of coal for steam power in this district is £1 to £1 10s. per ton, and labour of firemen and engineers from 10s. to 16s. per day.

SOURCES OF REVENUE.

Within a radius of sixteen miles, there are Mining Towns and Mines, Sampling Works, Smelters, Railways, as well as Mills for industrial uses, that now use Steam to the extent of at least 10,000-horse power, all of which would be glad to avail themselves of the economy which this Company can offer them.

ESTIMATE OF REVENUE FROM THE PIONEER PLANT.

	Minimum delivery of 2000-horse power.	
2000-horse power at $100 per annum per horse power =	$200,000 per annum.	
Equal to		£40,000 per annum.
7 per cent. on £105,000 Preference Shares	£7,350	
14 per cent. on £105,000 Ordinary Shares	14,700	
Working, Administration, and other Expenses	7,000	
Depreciation and Contingencies	10,950	
		£40,000

A contract assignable to the Company has already been secured by the Vendor for ten years for 1000-horse power, at $120 per horse power per annum = £24,000 per annum.

With a very small outlay for plant, the above income can be greatly increased and, as the cost of steam power in the district exceeds $180 per horse power per annum, the Directors regard $100 per horse power as a fair commercial price.

In addition to the water power, lands, electrical plant, and accessories, the Company will own several gold and silver mining claims in, and adjacent to, Cottonwood Canon, which promise large returns. These mining claims, which are known as "The Lucky Boys," are located close to well-known mines, which are, and for a long time have been, very successful.

It is not the intention of the Company to work these mines, but to sell them; and it is expected that they will realize a considerable sum, especially as the recent discoveries of improved processes for working gold and silver ore have increased the value of all Utah mines.

The Vendor has contracted with the Company to provide, erect, and construct, to the satisfaction of the Directors, all the necessary plant and machinery to enable the Company to supply at the various points of distribution electrical energy equivalent in the aggregate to 2000-horse power, and to pay the preliminary costs, charges, and expenses of the promotion and formation of the Company, down to the first general allotment of shares. The price to be paid for the property and rights agreed to be sold, inclusive both of the cost of the provision, erection, and construction of such plant and machinery, and of such preliminary costs, is £200,000, payable as follows: As to £35,000 in fully-paid Preference Shares of the Company, as to £35,000 in fully-paid Ordinary Shares of the Company, and as to the balance of £130,000, in Cash or Securities of the Company, or partly in Cash and partly in Securities of the Company, as the Directors may determine.

The above-mentioned contract is the only contract that has been entered into by this Company; and it is made between John Elliot Condict (as vendor) of the one part and this Company of the other part, and is dated the 14th of March, 1896; the said John Elliot Condict has or may have entered into contracts for the purpose of carrying out the aforesaid contract, and there are, or may be, other contracts made by or on behalf of John Elliot Condict and others with reference to the acquisition of the said properties, to none of which the Company is a party. These contracts are or may be contracts within the meaning of the 38th section of the Companies Act, 1867. Applicants shall be deemed to have had for all purposes full notice of every contract referred to above, and to have waived their rights (if any) to any further particulars thereof, whether under the Companies Act of 1867 or otherwise.

The original reports and the contract of the 14th day of March, 1896, above mentioned, and the Memorandum and Articles of Association of the Company, can be inspected at the Offices of the Solicitors of the Company.

A Sketch Map of the district is endorsed on the Prospectus. The lines of wire for conveying the electrical current will be erected by the Vendor from the Power House marked upon the Map, westward through the towns of Sandy and Murray to Bingham and eastward to the town of Alta.

Application for Shares must be made on the Form annexed to the Prospectus, and sent with the requisite Deposit to the Bankers of the Company.

Should no allotment be made to any applicant, the amount of Deposit will be returned in full; and should a less number of Shares be allotted to any applicant than is applied for, the surplus of the deposit will be applied to the sum due on allotment.

A quotation will be asked for on the London Stock Exchange.

Prospectuses and Forms of Application can be obtained from the Bankers, Brokers, or Solicitors, as well as at the Office of the Company.

London, March 14, 1896.

Preliminary Notice.

A DIVIDEND OF 6 PER CENT. PER ANNUM FOR THE NEXT THREE YEARS HAS BEEN GUARANTEED UPON THE PAID-UP CAPITAL OF THE COMPANY.

THE HOLYHEAD & NORTH WALES GAS & WATER CORPORATION, LIMITED,

Has been formed to acquire and amalgamate the following Gas and Water Works:—

HOLYHEAD GAS-WORKS, LLANRWST GAS-WORKS, BETTWS-Y-COED GAS-WORKS, MENAI BRIDGE GAS-WORKS, PENMAENMAWR GAS-WORKS, LLANBERIS GAS-WORKS, NANTLLE GAS-WORKS, LLANFAIRFECHAN GAS-WORKS, PWLLHELI GAS-WORKS, LLANBERIS WATER-WORKS.

CAPITAL £100,000, divided into 100,000 Shares of £1 each,

upon which it is proposed at present to call up the sum of 15s. per Share. 20,000 Shares are reserved for issue at par to the Shareholders and others interested in the above Undertakings.

Issue of balance, 80,000 Shares of £1 each, at a premium of 10 per cent., payable 2s. 6d. on application, 5s. and premium on allotment, and 7s. 6d. one month after allotment, and the balance with not less than 30 days' notice as and when required.

The following Table shows the present Market Value of the Shares of a few Companies similar to this Corporation:—

British Gaslight, Limited . . .	£20 Shares	..	£54½ to £55½	Brentford (Middlesex) Gas Co. .	£100 Stock	..	£278 to £283
Continental Union, Limited . .	£100 Stock	..	£270 to £275	Richmond (Surrey) Gas Company	£100 Stock	..	£215 to £220
Imperial Continental	£100 Stock	..	£250 to £255	South Metropolitan Gas Company	£100 Stock	..	£378 to £383
Croydon Commercial Gas & Coke Company	£100 Stock	..	£280 to £285	Liverpool United Gaslight Company	£100 Stock	..	£238
The Gaslight & Coke Company .	£100 Stock	..	£302 to £307	Elland (Yorks.) Gas Company .	£10 Shares	..	£28 to £30

That Gas Undertakings generally afford a sound and remunerative Investment is admitted; and the following extract (as published by the "Gas Engineer's Magazine"), from the last Board of Trade Returns compiled, emphasizes this fact in a truly remarkable manner:—

"One hundred and fifty six Companies paid a Dividend of 10 per cent. on their Original Capital, and forty-four paid Dividends varying from 10½ to 20½ per cent."

As will be seen by the above extract, 156 Companies paid Dividends of 10 per cent. for the year 1894; and it is instructive to note that the concerns giving a similar return were in 1893, 142; 1892, 153; 1891, 158; and 1890, 155—showing the steady level of profit-earning attained by investments of this nature.

The total number of Gas Undertakings in the United Kingdom varied from 405 in 1890 to 418 in 1894; and the average Dividends paid by these Companies have been as follows: In 1890, £8 9s. 4¾d. per cent.; 1891, £8 7s. 10¾d. per cent.; 1892, £8 3s. 11¾d. per cent.; 1893, £7 18s. 1d. per cent.; 1894, £8 2s. per cent.

The vendor feels so satisfied with the past results, and is so confident of the future success of the undertaking, that he has entered into an agreement with the Company that he will, upon completion of the purchase, set aside a sum which shall be sufficient to pay a Dividend of 6 per cent. per annum for the first three years upon the paid-up Capital of the Company. The amount required for payment of said Dividend will, upon the completion of purchase, be deposited, in the names of two Trustees, in the Union Bank of Manchester, and shall be held in trust for the payment of the said Dividend.

£25,000 of the present Capital is reserved for further Development, Extensions, and Renewals.

Prospectuses may be obtained from the Secretary, W. H. Sinclair, 9, 10, 11, Examiner Buildings, Manchester.

FORM OF APPLICATION FOR SHARES.

(TO BE RETAINED BY THE BANKERS.)

The Holyhead and North Wales Gas & Water Corporation, Limited.

To the Directors of the Holyhead and North Wales Gas and Water Corporation, Limited.

Gentlemen,—Having paid to your Bankers, The Union Bank of Manchester, Limited, or their London Agents, Messrs. Glyn, Mills, Currie, and Co., or to the Metropolitan Bank of England and Wales, Bangor, and its Branches, the sum of £ , being a deposit of 2s. 6d. per share on Shares of £1 each in the above-named Company, I request you to allot me that number of Shares; and I agree to accept the same or any smaller number that may be allotted to me, subject to the Memorandum and Articles of Association. I authorize you to place my name on the Register of Members in respect of the Shares so to be allotted to me, and agree to pay the further instalments upon such allotted Shares as the same shall become due. I hereby waive all rights to further Particulars of any Agreements whether under Section 36 of the Companies Acts, 1867, or otherwise.

Ordinary Signature.....

Name in full.....

Address.....

Description.....

Date.....

NOTICE.

Whereas it has come to the knowledge of the INCANDESCENT GAS-LIGHT COMPANY, Limited, of Palmer Street, Westminster, that a Company called the Meteor Incandescent Gas-Light Company, Limited, a firm known as Putz and Co., and a Company known as the Evening Sunlight Incandescent Light Company or the New Incandescent Light Company, are selling, and are offering for sale, forms of Incandescent Gas-Lights called respectively the "Meteor," the "Champion," and the "Evening Sunlight,"

THIS IS TO GIVE NOTICE, THAT THE INCANDESCENT GAS-LIGHT COMPANY, LIMITED, will commence ACTIONS FOR INFRINGEMENTS OF THEIR PATENTS against all persons found dealing in any manner with the said "Meteor," "Champion," or "Evening Sunlight" Incandescent Gas-Lights, which are all constructed in Infringement of the Patent of the Incandescent Gas-Light Company, Limited.

The validity of the Company's Patent has been certified by the Hon. Mr. Justice Romer.

FAITHFULL & OWEN,
11, Victoria Street, S.W.
Solicitors for the Incandescent Gas-Light Company, Limited.

NOTICE.

THE INCANDESCENT GAS-LIGHT COMPANY, LIMITED, Hereby Give Notice, that they only supply their Mantles subject to the following express Conditions, which are printed and pasted on each box:—

"The Incandescent Gas-Light Company, Limited, in supplying the Mantle contained in this box, grant a Limited License to the purchaser to sell or use the same on the express condition that neither the purchaser nor any other person into whose hands the same may come shall use or sell the said Mantle except in connection, or for use, with Burners sold or supplied by the Company; any other sale or use will amount to Infringement of the Company's Patents. The Company supply Mantles for the purpose of renewals at the nominal price of 1s. 3d., subject to the Conditions and Limitations above set forth."

In the case of *The Incandescent Gas-Light Company, Limited v. Cantelo*, Mr. Justice Wills upheld the Validity of these Conditions and Limited License; and, in the course of his Judgment, said:—

The patentee has the sole right of using and selling the articles; and he may prevent anybody from dealing with them at all. Inasmuch as he has the right to prevent people from using them or dealing in them at all, he has the right to do the lesser thing—that is to say, to impose his own conditions. It does not matter how unreasonable or how absurd the conditions are. It does not matter what they are if he says at the time when the purchaser proposes to buy, or the person proposes to take a license: 'Mind I only give you this license on this condition;' and the purchaser is free to leave it or take it as he likes. If he takes it, he must be bound by the condition."

In the case of *The Incandescent Gas-Light Company v. Hirschfeld and Others*, the Honourable Mr. Justice Romer certified that the Validity of the Plaintiffs' Patents was established. Infringers in future will be liable to costs as between Solicitor and Client.

(Signed) FAITHFULL & OWEN,
Solicitors for the Incandescent Gas-Light Company, Limited.

THE INCANDESCENT GAS-LIGHT COMPANY, LIMITED.

WARNING.

THE INCANDESCENT GAS-LIGHT COMPANY, LIMITED.

WHEREAS, it has been brought to the notice of the INCANDESCENT GAS-LIGHT COMPANY, LIMITED, THAT DIVERS FIRMS UPON THE CONTINENT OF EUROPE are Manufacturing Incandescent Gas-Mantles, and are sending the same into this Country, and are advertising for Agents to push the sale of these Mantles,

THIS IS TO GIVE NOTICE, THAT ALL SUCH MANTLES ARE INFRINGEMENTS OF THE COMPANY'S PATENT, and that the Company will take proceedings for Infringement against all persons purchasing or using any of such Incandescent Gas-Mantles. THE COMPANY OWN THE MASTER PATENTS in this Country for the manufacture of Incandescent Gas-Mantles, and the validity of such Patents has already been certified by the Honourable Mr. Justice Romer, and the Company will enforce their Patent Rights against all Infringers.

FAITHFULL & OWEN,
Solicitors for the Incandescent Gas-Light Company, Limited.
11, Victoria Street, Westminster.

NOTICE.

The attention of the METEOR INCANDESCENT LIGHTING COMPANY, LIMITED, having been again called to the Advertisements inserted in various papers by the Incandescent Gas-Light Company, Limited, of Palmer Street, Westminster, to the effect that the "Meteor" Incandescent Gas-Lights are an Infringement of their Patents, and that they will bring Actions for Infringement against all persons found dealing in any manner with such Lights, the METEOR INCANDESCENT LIGHTING COMPANY, LIMITED, HEREBY GIVE NOTICE that they are advised that the "Meteor" Incandescent Lights in no way infringe any of the Patents of the Incandescent Gas-Light Company, Limited, that an Action has been commenced to restrain such threats, and that they are PREPARED TO FULLY INDEMNIFY ALL PURCHASERS, DEALERS, AGENTS, and USERS of their Lights against any Legal Proceedings on the part of the Incandescent Gas-Light Company, Limited.

WILSON, BRISTOWS, & CARPMAEL,
1, Copthall Buildings, London, E.C.,
Solicitors to the Meteor Incandescent Lighting Company, Limited, of 35, New Broad Street, London, E.C.
Nov. 30, 1895.

LOW MOOR BLACK BED
GAS COAL.
YIELD OF GAS PER TON - 10,375 CUBIC FEET.
ILLUMINATING POWER - 17·50 SPERM CANDLES.
COKE - - - - - - - - 75 PER CENT.
Prices, f.o.r. or f.o.b., on application to
GEORGE & JOHN HAIGH,
RAVENS LODGE AND CONYERS' COLLIERIES,
DEWSBURY.
A TRIAL IS RESPECTFULLY SOLICITED.

PRICE'S PATENT COKE & COAL BARROW

effecting a great saving of time, labour, and expense.
For Particulars, Price, &c., apply to Mr. E. PRICE, Inventor and Patentee, 119, Queen's Road, FINSBURY PARK, N.
Prices are Reduced.

NEWBATTLE CANNEL.
Highest Results in Gas, & Excellent Coke.
QUOTATIONS ON APPLICATION TO
THE LOTHIAN COAL COMPANY,
LIMITED,
NEWBATTLE COLLIERIES,
DALKEITH, N.B.

JUNKERS' CALORIMETER
SHOWS AT A GLANCE THE HEATING VALUE OF GAS.
NO BOMB. NO ANALYSIS.
See Illustrated Advertisement in the "JOURNAL" for March 3, p. 488.
Reduced Price £15 15s.
HERMANN KÜHNE,
25-35, New Broad Street, London, E.C.

ESTABLISHED 1862. NEW GAS PLANT CEMENT
For all Joints in connection with
SULPHATE PLANT. OIL-GAS PLANT. GAS. TAR. AMMONIA.
SAMPLES ON APPLICATION.
SPECIAL PAINTS FOR GAS-WORKS.
Telegrams "Enamel." Nat. Tel. 1759.
TRADE MARK.
John E. Williams & Co., *Victoria Paint Works*, Manchester.

HUNTER'S
OXIDE OF IRON.
JAMES HUNTER, MINER, AND SHIPPER OF
NATURAL IRISH BOG ORE.
This Estate yields the finest and most uniform quality in Ireland; and the quality is guaranteed.
Samples and Prices on application.
5, PRINCES STREET, PORT GLASGOW.
Telegrams: "HUNTER, PORT GLASGOW."
Established 1872.

UNEQUALLED.
Gas Companies are solicited to try Samples of the
MIRFIELD
BLACK BED GAS COAL.
Prices and Analysis on application.
MIRFIELD (GAS-COAL) COLLIERY COMPY.
RAVENSTHORPE, NEAR DEWSBURY.

LONDONDERRY GAS COALS
FROM THE
MARQUIS OF LONDONDERRY'S
COLLIERIES,
COUNTY OF DURHAM.
Available output up to 5000 tons per day.
Yield of Gas 11,000 cubic feet per ton of Coal as per analysis by
Mr. John Pattinson, F.C.S., F.I.S.
FOR PRICES AND PARTICULARS, APPLY TO
S. J. DITCHFIELD,
SEAHAM HARBOUR, COUNTY OF DURHAM.

TROTTER, HAINES, & CORBETT,
Brettell's Estate
FIRE-CLAY & BRICK WORKS,
STOURBRIDGE.

Manufacturers of GAS-RETORTS, GLASSHOUSE FURNACE & BLAST-FURNACE BRICKS, LUMPS, TILES, and every description of FIRE-BRICKS.
Proprietors of
BEST GLASSHOUSE POT & CRUCIBLE CLAY.
Shipments Promptly and Carefully Executed.

London Office: R. Cull, 84, Old Broad St., E.C.

HEBBURN MAIN GAS COALS.

Yield of Gas per ton . . . . . 10,500 cub. ft.
Illuminating Power . . . . . 16·4 candles.
Coke . . . . . 68 per cent.

For prices, f.o.b. Ship or Delivered by Rail, apply to
THE WALLSEND & HEBBURN COAL COMPANY, LTD.,
8 Lombard Street,
NEWCASTLE-ON-TYNE.
W. RICHARDSON, Fitter.

Following the acquisition of new Works situated in the heart of the cheapest Coal, Iron, and Steel Districts, we have added to our Technical Staff the
MOST SUCCESSFUL MODERN EXPERTS
in the designing of
AUTOMATIC
COAL & COKE HANDLING PLANTS
WE EARNESTLY WISH ENGINEERS TO INSPECT OUR LATEST DESIGNS.
New CONVEYOR Co., Ld.,
3 & 4, Lime Street Square, London, E.C.

BOLDON GAS COALS.
Worked by THE HARTON COAL CO., LTD.
Output about 3000 tons per day.

Analysis—

Yield of Gas per ton .	10,500	Cubic Feet.
Illuminating Power . .	16·9	Candles.
Coke	66·7	Coke.
Sulphur	0·86	Sulphur.
Ash	2·04	Ash.

Boldon Gas Coals are supplied under contract to
The Gaslight and Coke Company, South Metropolitan Gas Company, Commercial Gas Company, Imperial Continental Gas Association, European Gas Company, L'Union des Gaz (the Continental Union Gas Company), Crystal Palace District Gas Company, Danish Gas Company, Bombay Gas Company, San Paulo Gas Company, Alliance and Dublin Consumers' Gas Company, Ipswich Gaslight Company, Newcastle Gas Company, Sunderland Gas Company, South Shields Gas Company, and to many other Companies at Home and Abroad.

For prices, &c., apply to the
HARTON COAL COMPANY,
LIMITED,
Newcastle-on-Tyne.
W. H. PARKINSON,
Fitter.

ROBERT MARSHALL,
CANNEL COAL MERCHANT,
97, WELLINGTON STREET, GLASGOW.
Prices and Analysis of all the Scotch Cannels on Application.

THE SILICA FIRE-BRICK COMPANY,
OUGHTIBRIDGE, near SHEFFIELD,
MANUFACTURE
SILICA BLOCKS, BRICKS, AND CEMENT
OF SUPERIOR QUALITY
FOR GAS-FURNACES.
Trade Mark: "SILICA."

These Goods (largely used in Gas, Glass, Iron, and Steel Works) are, on account of their
GREATER DURABILITY,
Strongly recommended where EXCESSIVE HEATS have to be maintained.

THE DRUM
FOR PUMPING AIR, WATER, SEMI-FLUIDS, &c.
See Advertisement in last and next issue.

THORNLEY GAS COALS
WORKED BY THE
WEARDALE IRON & COAL Co., Ld.
OUT OF THEIR
THORNLEY AND WHEATLEY HILL COLLIERIES.

Analysis made by
Messrs. J. & H. S. PATTINSON, *May 28, 1895*,

Yield of Gas per Ton . .	10,500 Cub. Ft.
Illuminating Power . .	16·9 Candles.
Coke (of good quality) . .	67·5 per Cent.
Sulphur	0·58 ,,
Ash	2·73 ,,

For Price, &c., apply to the
WEARDALE IRON & COAL Co., Ld.
QUAYSIDE, NEWCASTLE-ON-TYNE.

THOMAS TURTON AND SONS, Limited,
SHEAF WORKS, SHEFFIELD,
MANUFACTURERS OF
FILES OF BEST QUALITY
FOR ENGINEERS.
STEEL OF ALL DESCRIPTIONS.
SCREW STOCKS, TAPS AND DIES,
SPANNERS, RATCHET BRACES, LIFTING JACKS,
ANVILS, VICES,
AND ENGINEERS' TOOLS GENERALLY.
London Office:
90, CANNON STREET, E.C.

Awarded HIGHEST MEDAL and DIPLOMA at the Newcastle-on-Tyne Royal Mining and Industrial Exhibition, 1887,
for
CANNEL & COAL.

TYNE BOGHEAD CANNEL.

Yield of Gas per ton	13,155 cub. ft.
Illuminating Power	38·22 candles.
Coke per ton	1,301·88 lbs.

EAST PONTOP GAS COAL.

Yield of Gas per ton	10,500 cub. ft.
Illuminating Power	16·3 candles.
Coke	70 per cent.

SOUTH PELAW MAIN GAS COAL.

Yield of Gas per ton	10,500 cub. ft.
Illuminating Power	16·3 candles.
Coke	73·1 per cent.

For Prices and complete Analysis, apply to
THOS. W. DANCE & SONS,
Coal Owners, Newcastle-on-Tyne;
OR
E. FOSTER & CO.,
12, John Street, Adelphi, London, W.C.

WILLEY & CO.,

GAS ENGINEERING CONTRACTORS,

EXETER,

For **GASHOLDERS** and all kinds of **ENGINEERING APPARATUS.**

For **WET** and **DRY GAS CONSUMERS' METERS.**

For **COIN METERS,** their Patent Automatic is admitted to be one of the best and most reliable in the Market. Largely used in the Metropolis.

For **GAS-FITTINGS,** Registered Designs in Extensive Variety.

Manufacturers of the **LIVESEY WASHER.**

Agents for the **MAXIM CARBURETTOR.**

New Works, 5 acres in extent, recently opened in the City of Exeter for the Manufacture of every kind of Apparatus used in the Production, Distribution, and Sale of Gas.

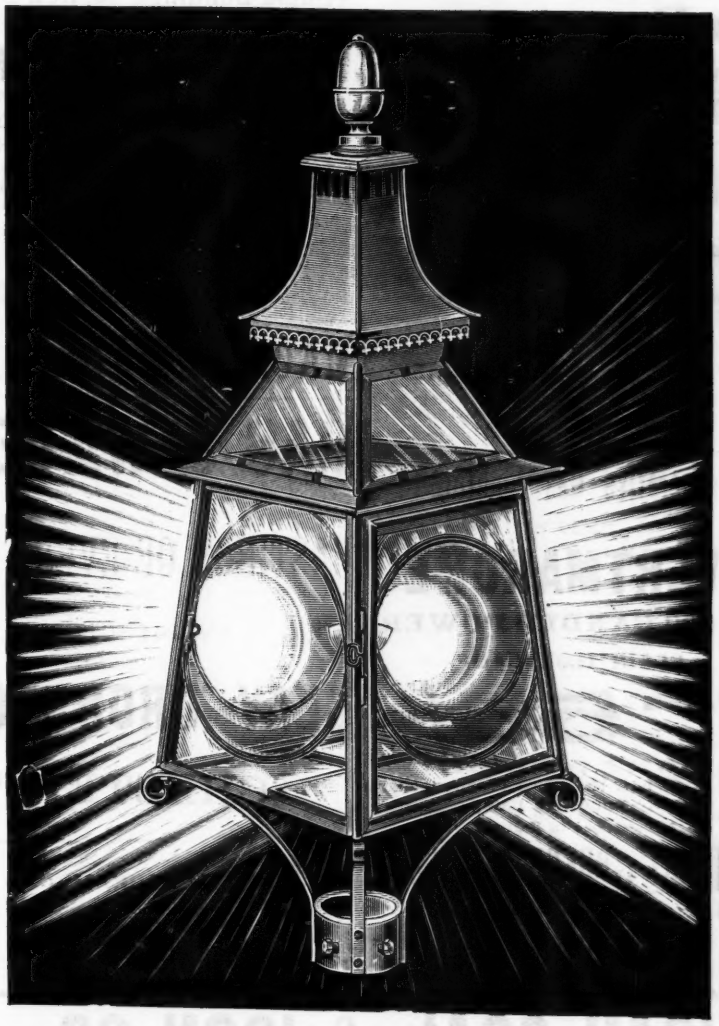
Telephone 132. **Telegraphic Address: "Willey, Exeter."**

ESTABLISHED 30 YEARS.

"LOFTUS"

PATENT STREET-LANTERNS

100 PER CENT. MORE LIGHT CAN BE OBTAINED FROM ANY FLAME BY USING THIS LANTERN INSTEAD OF THOSE NOW USED.



PUBLIC BODIES, CORPORATIONS, AND GAS COMPANIES CAN SAVE 50 PER CENT. BY USING THIS LANTERN FOR STREET LIGHTING.

Can be fitted for OIL where required.

No. 420 G.

FIRST COST LITTLE MORE THAN ORDINARY LANTERNS.

Exceedingly Brilliant Light in direction of Lenses, Lights Footway all along between Lamps.

For Further Particulars, inquire for PRICE LIST "L" from

THE SUNLIGHT & SAFETY LAMP CO., LTD.

ROSCAR WORKS, BIRMINGHAM.

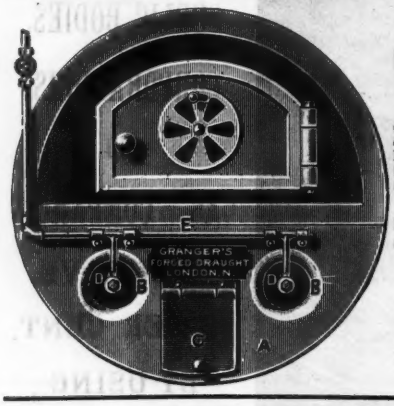
Telegraphic Address: "PROGRESS, BIRMINGHAM." A.B.C. Code used.

Or from London Agent: J. JONAS, 38, Lime Street, E.C., where a Specimen Lamp can be seen.

OSLER,
BIRMINGHAM.

MANUFACTURERS OF GASELIERS IN GLASS AND METAL.

FORCED DRAUGHT



GRANGER'S FORCED DRAUGHT FURNACE

Can be applied to any type of Boiler, and Burns all kinds of Cheap Fuel, Slack, Smudge, Pan Breeze, &c., also gives a large increase of Steam.

Many hundreds working at the leading Collieries, Mills, Factories, &c., &c.

WM. GRANGER,
BROOKE ROAD,
STOKE NEWINGTON,
LONDON, N.

The Climax of Regenerative Gas Lighting!!

THE
"VERTMARCHE"
A 280-CANDLE POWER
PLAIN IRON LAMP,
CLASS A— **55/-**

LIGHT for LIGHT
less than half the price of any other Regenerative Lamp.
Manufactured in England.

HENRY GREENE & SONS,
163 & 165, CANNON STREET,
LONDON BRIDGE, E.C.
PARTICULARS AND PRICES FREE. AGENTS WANTED.

WILSON CARTER & PEARSON,
GAS COAL AND CANNEL FACTORS,
Supply to any Railway Station, or for Export, all kinds of Fuel for Gas purposes.
ADDRESS CHIEF OFFICES:
Temple Buildings, 50, New Street, Birmingham.

WILLIAM INGHAM & SONS,
Incorporated with the Leeds Fire-Clay Company, Ltd.,
WORTLEY FIRE-CLAY WORKS,
Near LEEDS,

Have confidence in drawing the special attention of GAS ENGINEERS to the following advantages of their Retorts:—
1. Smooth interior, preventing adhesion of Carbon.
2. They can be made in one piece up to 10 feet long.
3. Uniformity in thickness, ensuring equal Expansion and Contraction.

PATENT
MACHINE-MADE GAS-RETORTS.

GAS & WATER PIPES
AND
CASTINGS OF EVERY DESCRIPTION.
MANUFACTURED BY THE
CLAY CROSS COMPANY,
CHESTERFIELD.

TRADE MARK. CXC | TELEGRAMS: "JACKSON" CLAY CROSS. | LONDON OFFICE: 12, BURWOOD PLACE, W.

THE WIGAN COAL & IRON CO., LIMTD.,
Are exclusive Owners of the well-known HAIGH HALL & KIRKLESS HALL GAS COAL COLLIERIES, and supply the Best Wigan Arley Mine Gas Coal, Gas Nuts, Gas Cannel, Cannel Nuts, &c.
MIDLAND DISTRICT OFFICE: 22, TEMPLE ST., BIRMINGHAM—SOLE AGENT: A. C. SCRIVENER.
TELEGRAPHIC ADDRESS: "WIGAN BIRMINGHAM." TELEPHONE NO. 200.
LONDON DISTRICT OFFICE: 6, STRAND, LONDON—C. PARKER & SON, SOLE AGENTS.
TELEGRAPHIC ADDRESS: "PARKER LONDON."

HEATHCOTE GAS COAL.
RICH IN ILLUMINATING POWER AND YIELD OF GAS.
ABOVE THE AVERAGE IN WEIGHT AND QUALITY OF COKE.
MAINTAINS A HIGH STANDARD IN RESIDUALS.
THE GRASSMOOR Co., Ld., CHESTERFIELD.

ALEX. C. HUMPHREYS, M.Inst.C.E. A. G. GLASGOW, M.E.

MESSRS. HUMPHREYS & GLASGOW

Have constructed their EUROPEAN type of

CARBURETTED WATER-GAS PLANT

At the following Gas-Works:—

Copenhagen	700,000 Cub. Ft.	Liverpool	2,500,000 Cub. Ft.
Belfast	1,700,000 „	Tottenham	600,000 „
Glasgow	300,000 „	Brighton	1,250,000 „
Brussels	700,000 „	Bath	1,000,000 „
Santiago	400,000 „	New York	1,000,000 „
Swansea	700,000 „	Newburgh, N.Y.	350,000 „

And have now under Contract:—

Belfast (Second Contract)	3,500,000 Cub. Ft.	Manchester	3,000,000 Cub. Ft.
Preston	1,500,000 „	Brussels (Second Contract)	700,000 „
Southport	750,000 „	St. Joseph, Mo.	750,000 „
Tottenham (Second Contract)	750,000 „	Holyoke, Mass.	500,000 „

In addition to which the previous Installations of The Gaslight and Coke Company under this System have a total capacity of 10,000,000 cubic feet per diem.

9, Victoria Street, London, S.W.

Telegrams: "EPISTOLARY, LONDON."

United States Office, 64, Broadway, New York.

JOHN BROWN & CO., LTD., SHEFFIELD,

Proprietors of

ALDWARKE MAIN CAR HOUSE & ROTHERHAM MAIN COLLIERIES, NEAR ROTHERHAM.

ALDWARKE MAIN GAS COAL

Analysis: 12,600 feet of 19-candle gas per ton.
Weight of illuminating power in pounds of sperm, 820·80. Very free from impurities.
Telegrams: "ATLAS SHEFFIELD."

Special Notice

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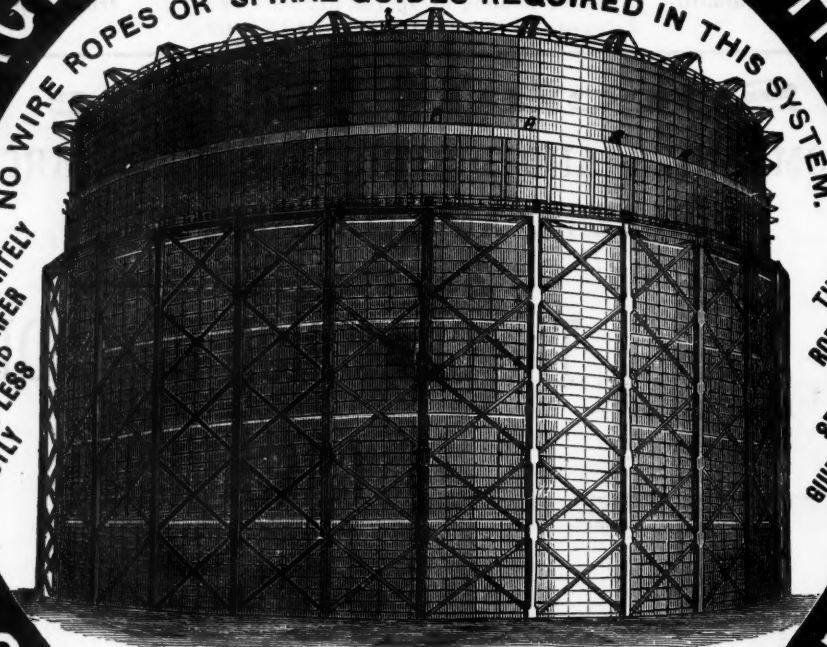

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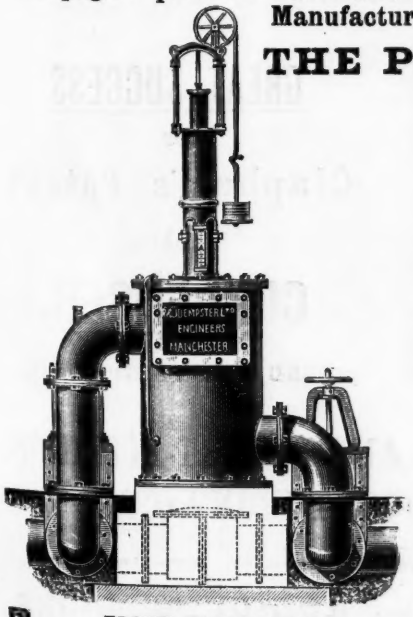

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The large number in use is sufficient proof of its utility. By the almost complete elimination of Tar, which is effected to the extent of 99·7 per cent., it facilitates Purification in the Purifiers, by preventing the clogging or obstruction of the Purifying Materials, which, in consequence, last much longer; thus effecting a Saving both in Materials and Labour.

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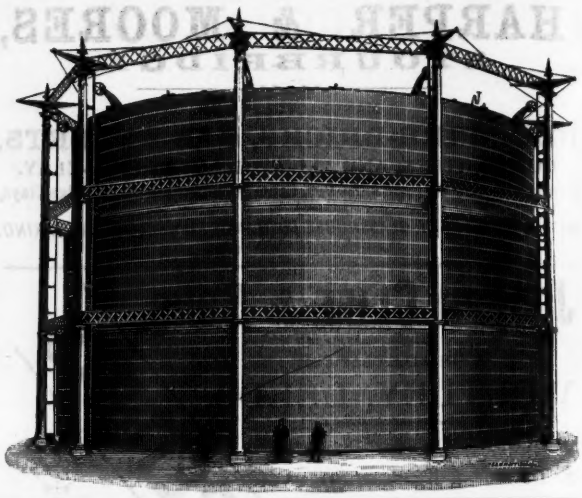

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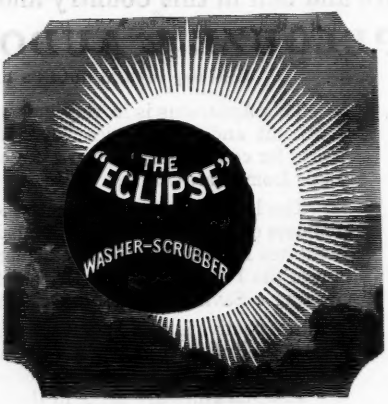

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